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THE AUTOMOBILE

Scientific Classification of Tire Uses

To Reduce Tire Cost Suppress Obvious Abuses

G. A. Wells, Jr., having made an extended investigation of tires, presents the matter in the right light, using charts to show the critical relations. It would appear from the information at hand that tire diameter offers the best field for investigation, and the practice of increasing the section of the tire of a given diameter is deprecated, reducing this practice to the level of a mere expedient in the attempt to alleviate the ills, which can only be looked upon as making the best of a bad situation. The energy in footpounds, due to impact, in the negotiation of road obstructions, is figured out for various diameters of tires, and a tabulation, giving draw-bar pull, and horsepower requirement per ton for various speeds, is presented.

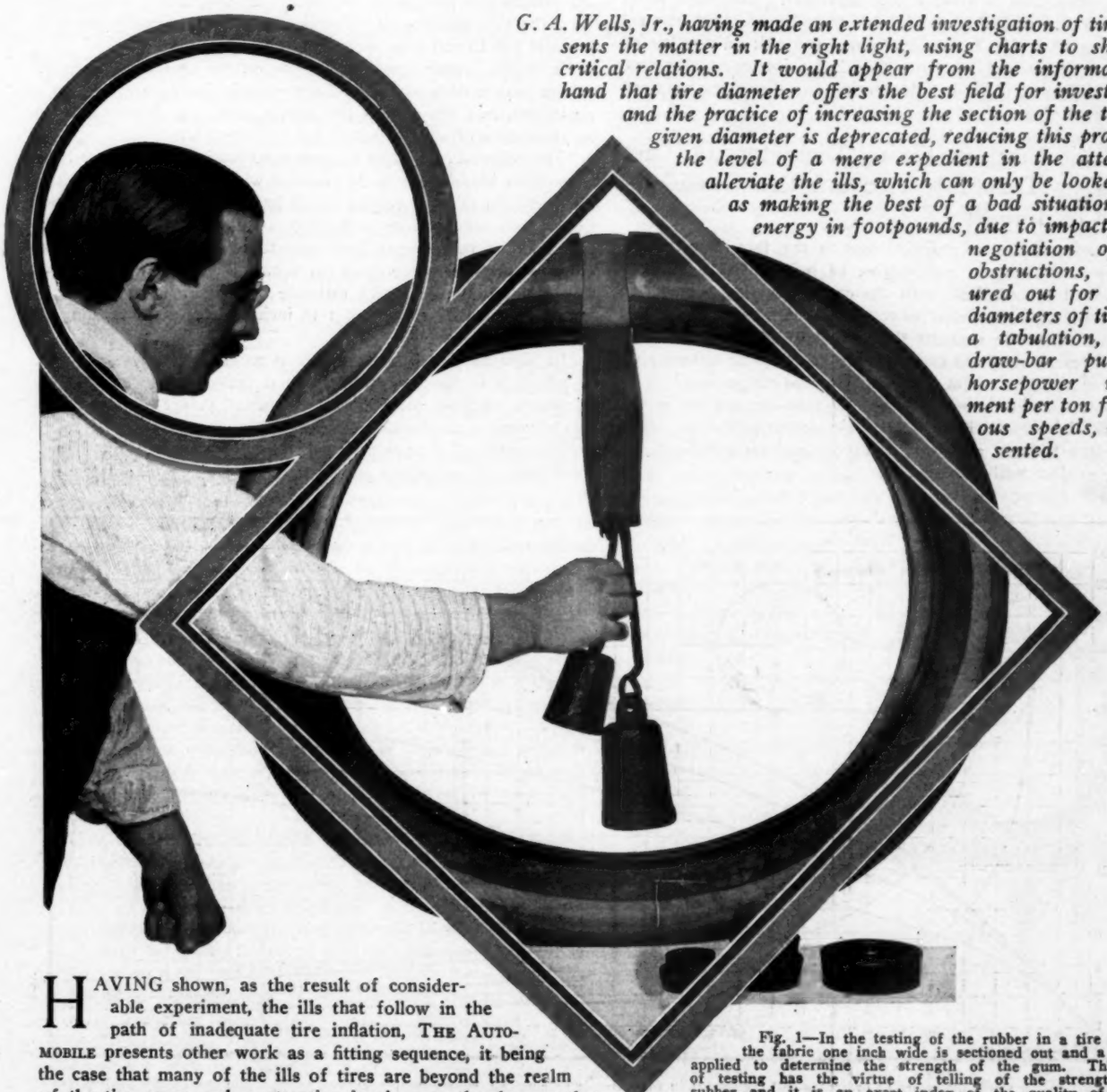


Fig. 1—In the testing of the rubber in a tire a strip of the fabric one inch wide is sectioned out and a weight is applied to determine the strength of the gum. This method of testing has the virtue of telling of the strength of the rubber and it is an exact index of the quality of the gum for tire purposes

HAVING shown, as the result of considerable experiment, the ills that follow in the path of inadequate tire inflation, THE AUTOMOBILE presents other work as a fitting sequence, it being the case that many of the ills of tires are beyond the realm of the tire pump, unless attention is given to the damage that

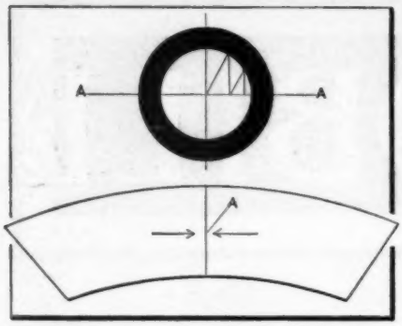


Fig. 2—Diagram for use in estimating the stress on the fabric of a tire due to inflation.

will result if the tires are too large in section, considering diameter, for the work to be done, in which event over-inflation is a menace that must receive the careful consideration of the makers of automobiles, since it lies with them to select the sizes of tires that are to be used in their wares.

Within the last year or two, when the makers of tires and the users of automobiles discovered that the rate of depreciation was greatly in excess of the normal expectation, the conclusion was reached that the diameters of the tires used were insufficient to cope with the responsibilities imposed, and the practice of increasing tire-section was introduced as a temporary expedient. Immediate relief was the result, but unfortunately, this measure of relief was accepted as a basis for future operation, and quite a number of the makers of automobiles, when they had a chance to overcome the main difficulty, instead of increasing tire diameters, retained the offending diameters.

The Basis Used in Fixing Diameters of Tires Fails to Take Into Account the Considerations of Impact

Complication arose in practice, due to the fact that the instructions to maintain a high degree of inflation of tires were only intended for application in the cases involving the use of tires of the proper diameter, whereas with large-section tires to inflate them up to the pressure that would be efficacious in large diameter tires would be to endanger the fabric. This diversity of complicated situations is at the bottom of the undue tire bills in all such cases, and it is believed that the time has arrived in the automobile business when a scientific investigation of tires would reduce the cost of operation of automobiles sufficiently to make the project well worth while.

When the designer of an automobile determines the size of the propeller shaft of the car, he goes through a series of calculations to find out the effect of the torque of the motor upon this torsional member, and the power required to drive the car under the most pressing road conditions is given its quota of attention. But when the tires are being considered, the weight of the automobile is taken as the basis of estimate, and the result is that the same diameter of tires is selected for an automobile weighing, say, 3,000 pounds, whether the motor is capable of delivering 30 horsepower, or twice as much, nor does the question of torque come into the discussion, notwithstanding the fact that one make of 30-horsepower motor may be capable of delivering twice the torquing moment that might be looked upon as the normal expectation from another make of motor.

In Recounting the Advantages of Scientific Treatment of the Pneumatic Tire Problem, the Tensile Strength of Rubber Under Service Conditions Must Be Ascertained

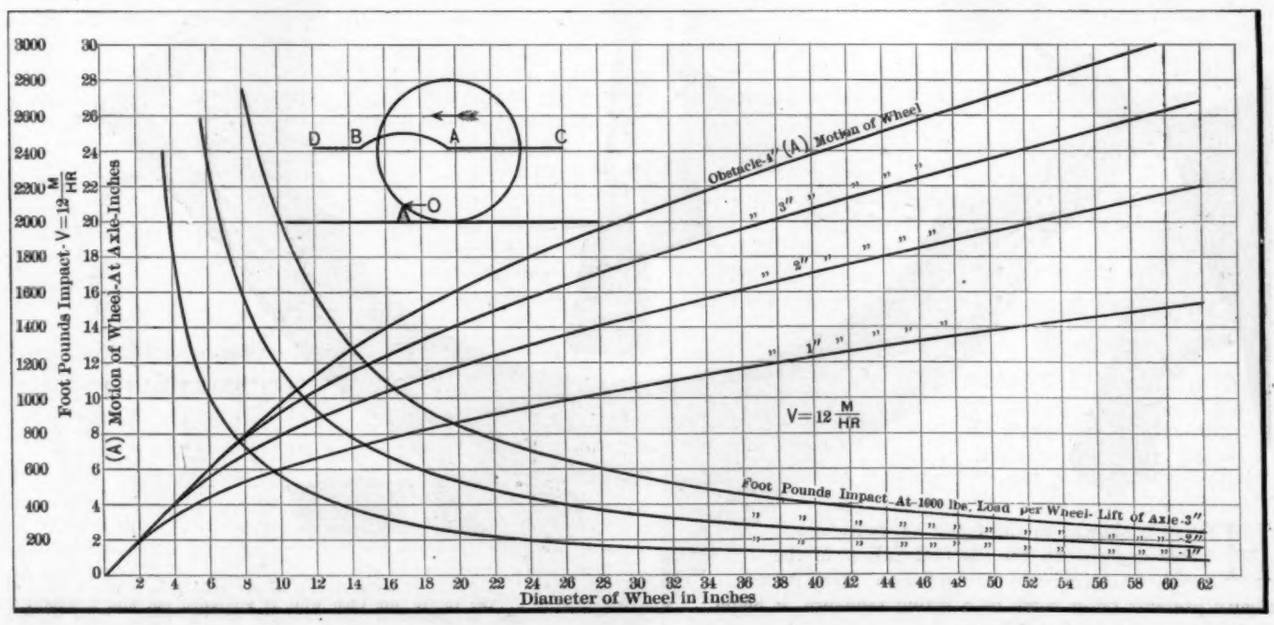
"Referring to the tire situation in general, and the pneumatic tire situation in particular, for motor vehicles, and in view of the fact that new designs for vehicles are being continually laid out, I would beg to call your attention to certain facts.

"It would appear from tests made on the tensile strength of rubber that it does not exceed 250 pounds per square inch as a maximum, and 180 pounds per square inch as a minimum, with an elongation of approximately 100 per cent.

"The railroad companies in their specifications for rubber hose of various kinds, have to be satisfied with a frictioning of skim coat between plies of canvas which parts at some 25 pounds per linear inch when force is applied as in Fig. 1, which would indicate that rubber may be frictioned to fabric to withstand a stress of not over 160 pounds per square inch, which figure I believe would be quite a high estimate (this is assuming that rubber is strained over an area 1-16 inch wide and 1 inch long in this test).

"In view of the following facts it would certainly seem that a reduction in the operating inflation pressures is certainly an absolutely essential condition to be attained before the pneumatic tire becomes a commercial success.

"The walls of a pneumatic tire are much more rigid than I think they are commonly supposed to be. Let us take as an ex-


Foot Pounds Impact-V=12 M/HR
(A) Motion of Wheel-At Axle-Inches
Diameter of Wheel in Inches
D B A C
O
Obstacle-4" (A) Motion of Wheel
3" " " " "
2" " " " "
1" " " " "
V=12 M/HR
Foot Pounds Impact-At-1600 lbs. Load per Wheel-Lift of Axle-3"
" " " "

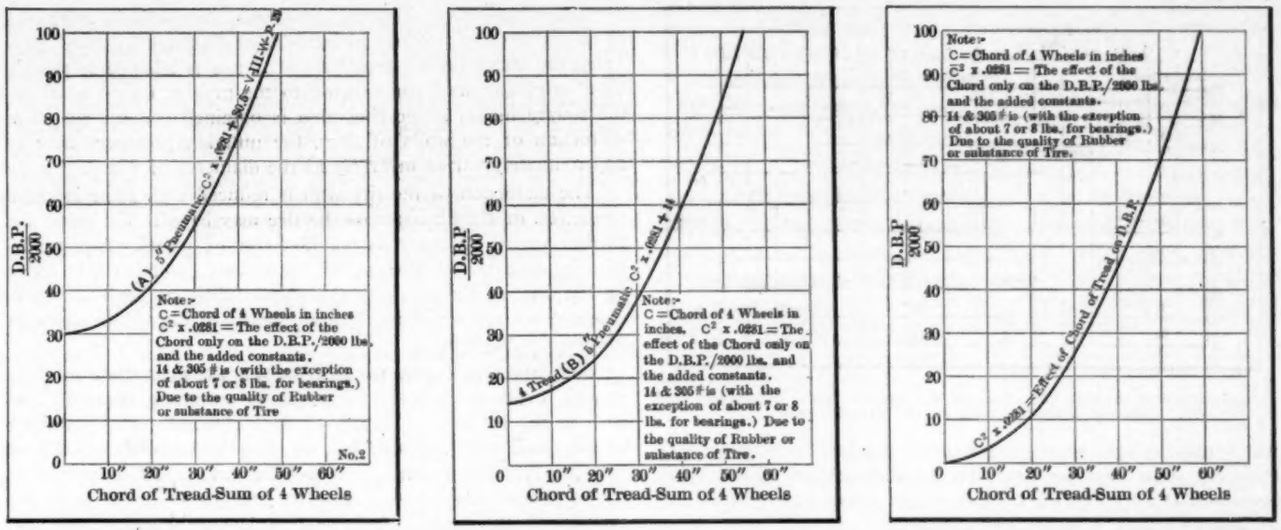

D.B.P. / 2000
Chord of Tread-Sum of 4 Wheels
(A) 3" Pneumatic
Note:-
C = Chord of 4 Wheels in inches
C² x .0281 = The effect of the Chord only on the D.B.P./2000 lbs. and the added constants.
14 & 305 # is (with the exception of about 7 or 8 lbs. for bearings.) Due to the quality of Rubber or substance of Tire
No.2
4 Tread (B) 3" Pneumatic
Note:-
C = Chord of 4 Wheels in inches. C² x .0281 = The effect of the Chord only on the D.B.P./2000 lbs. and the added constants.
14 & 305 # is (with the exception of about 7 or 8 lbs. for bearings.) Due to the quality of Rubber or substance of Tire.
Note:-
C = Chord of 4 Wheels in inches
C² x .0281 = The effect of the Chord only on the D.B.P./2000 lbs. and the added constants.
14 & 305 # is (with the exception of about 7 or 8 lbs. for bearings.) Due to the quality of Rubber or substance of Tire.
C² x .0281 = Effect of Chord of Tread on D.B.P.

Fig. 5.—Three relating diagrams (A) showing the relation of the chord of tread of four wheels to delivered power; (B) a second curve showing another variation of the same idea, and (C) showing the third curve, giving the effect of chord of tread on (D.B.P.) draw-bar pull, which curves were originally superimposed, but were separated for presentation here with a view to simplicity

ample a 5-inch tire, which is inflated at 125 pounds pressure. The stresses along the treads of the fabric would, when heated in operating under road conditions in summer, be 200 pounds per linear inch. That is to say, there will be 200 pounds stress on each system of perpendicular threads of which the fabric is composed.

"These figures are based upon a calculation made upon the bursting stresses in 5-inch pneumatic tires.

"The several layers of fabric when subjected to these perpendicular stresses within its own plane of 200 pounds per linear inch in each direction, and backed up by a force of 125 pounds per square inch normal to the above, must of necessity present a very unyielding surface.

"Tires, when operated, are continually receiving shocks of various kinds which approach dangerously near the limit of strength of the substances used in their construction. The intensity of these shocks is not due directly to the load on each wheel, but rather due to the high inflation pressures at which it is necessary to operate with the present diameter of wheels. The high inflation pressure causes the substance of tire walls to be so rigid and unyielding that these walls act as a heavy anvil or rigid roller might when backing up a substance, being subjected to a force almost sufficient to cause its disintegration. Then also the walls themselves, which are built of several layers of different substances united, some (fabric) only receiving the various stresses, and others (rubber) simply acting as a binder for the fabric layers, are continually being subjected to unequal distortion when in operation which, owing to the fact that high inflation pressures are at present necessary, and due to the consequent and unyielding character of the various layers composing the wall, is in a very limited time bound to produce a separation of the layers, and cause a harsh rubbing of the threads upon each other of any square woven fabric which may be used in tire construction.

"The diameter of the tire should be reduced, as by this means the stresses in the plane of the fabric may be reduced, thus securing a less rigid base presented to shocks, and then also the cutting of the fabric upon itself will be less severe, walls being made thinner, and the situation generally improved, as the D. B. P. will be lower, owing to the fact that we have less substance or material in the tire to absorb energy when in operation.

"With the object in view of attaining these several advantages, namely, reduction in inflation pressures, and reduction in tire sectional diameters, I would request, and believe it possible, to improve the form of rims now in general use. In the newest styles the rims cover some 6 1-2 inches of the sectional periphery of a 5-inch tire whose circumference is but 15.7 inches, or they cover 41.4 per cent. of the entire periphery, thus reducing the active portion of the tire to 58.6 per cent., which is a useless waste of expensive material, whereas if the rims were designed with a view of using the entire available circumference of tire, a tire of much smaller section might be used without change in the resiliency; that is, I believe, a tire 3 inches in diameter would give a resiliency equal to a 5-inch tire were such a rim used.

"The form of rim I would recommend is as follows:

"The width of tread where the tire makes contact on roadbed is determined by the inflation pressure, sectional diameter of tire and circumference of wheel. The rim is made with flat base equal in width to the tread, then side rims are designed with an arc somewhat greater in radius than the normal compressed or loaded form of tire, and should not extend lower than 1-4 or 1-3 inch. The tire would then when loaded fit the rim, but when not loaded it simply lays in the rim, not being held laterally at all when in this condition as shown in Fig. 3. Tire is fixed to rim by center lugs with studs or bolts. The same general effect which this rim attains may also be secured by using flat or square bases molded into the tire mounted on any form of rim which would allow the tire to assume a natural seat under load.

"This feature of a properly designed rim will, I believe, have almost as great an effect on satisfactory life of a tire as that of increasing diameters of wheels.

"By increasing the diameter of wheels the greatest advantages may be attained provided the step be carried far enough.

"Attached are curves (Fig. 4) showing how the length of wave which the axle makes varies with the diameter of wheels up to 60 inches when mounting obstacles which cause motion of axle to vary in height from 1 to 4 inches, and also curves showing the foot-pounds impact when mounting obstacles

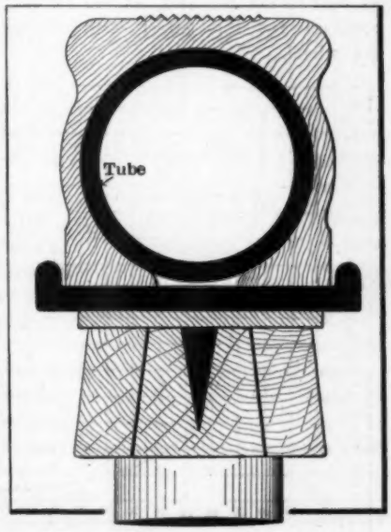


Fig. 3—Section of a tire for use in explaining a point to be made in the text involving rim cutting

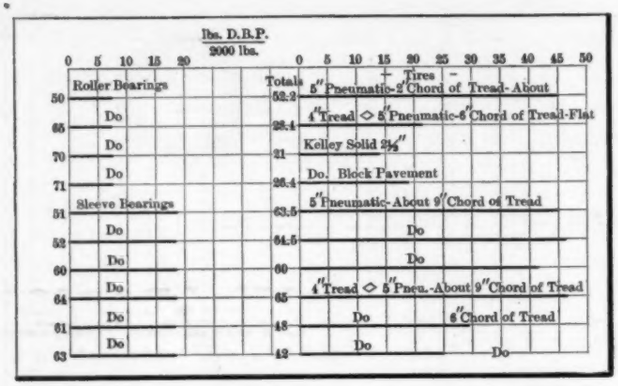


Fig. 6—Diagram showing the effect of the various types of bearings and different makes of tires on the draw-bar pull

which may be met by the wheel on a roadbed if vehicles were traveling at 12 miles per hour, for all diameters of wheels up to 60 inches, and for obstacles which would cause a vertical motion of axle of 1 inch, 2 inches and 3 inches.

"Here I would call your attention to the extreme desirability of keeping the moment of inertia of the running gear as low as possible, and of using the most resilient springs it is possible to apply for any particular kind of vehicle, as by so doing tires, while in operation, will receive the least possible injury from the effects of the impacts when mounting obstacles.

"In applying the term wave length to the motion of the axle, I used it to express the length of the wave A B, as shown in Fig. 4, which the axle describes when the wheel is rolling over an obstacle, as in the direction C to D (see diagram, Curve 1). This wave length varies with both the height of obstacle to be surmounted or the depression of the roadbed and the diameter of wheel.

"The diameter of tire may be reduced slightly for an increase in diameter of wheel due to this effect of increased wave length, still maintaining the same ease of motion at axle.

"The other and more important advantages of an increased diameter of wheel are that it allows of lower operating inflation pressure and a reduced diameter of tire, and a tire of thinner walls. It would seem almost unnecessary here to go into the exact change in shape of tread prints for varying diameters of wheels, although they may be readily calculated. It is interesting to note, however, that the length of the tread increases almost as circumference of wheel, the square inches of tread remaining constant for given axle load. It must not be assumed, though, that the draw-bar pull increases as the length of tread, as that is not the fact, as the D. B. P. remains approximately constant for this effect with variations of the diameter of the wheel.

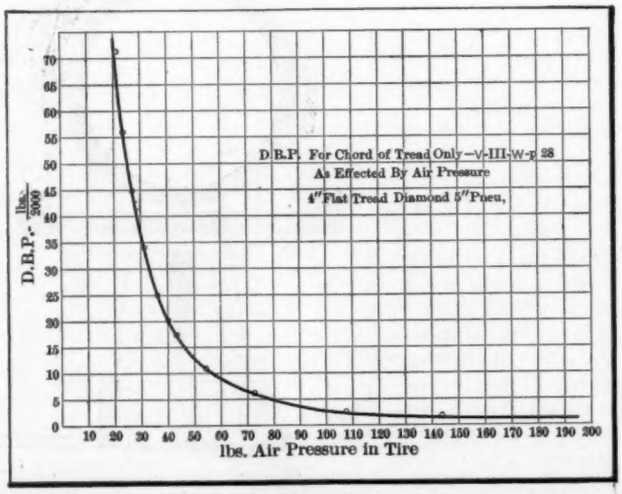

D.B.P. For Chord of Tread Only—V-III-W-F 28
As Effected By Air Pressure
4" Flat Tread Diamond 5" Pneu.
D.B.P.—lbs./2000
lbs. Air Pressure in Tire

Fig. 7—Chart giving the tire inflation pressure as ordinates and the draw-bar pull for a cord of tread only as abscissæ

"Lower operating inflation pressures are possible with the same diameter of tire for an increase in diameter of wheel, provided the distortion or compression of tire is allowed to remain as it originally was, since owing to the greater length of tread, the square inches supporting area is obtained; or for the same distortion of the walls of tires, the inflation pressures may be approximately varied inversely as the diameter of wheel.

"The distortion of the tire wall is reduced with same inflation pressures, or the diameter of the tire may be with the same distortion varied inversely as the diameter of wheel. Any reduction in diameter of tire, as we have seen, produces less stress on the wall of the tire, less cutting of fabric on itself, and also represents a more yielding base to shocks of impact on obstacles met on the roadbed.

"The curves in Fig. 4, which represent the magnitude of these shocks, or blow received by a tire in mounting obstacles met with in the roadbed, is expressed in footpounds, which obstacle would cause a lift of axle of 1, 2 or 3 inches with wheel load of 1,000 pounds rolling at a velocity of 12 miles per hour. These shocks invariably produce on tires an abnormal local distortion of the walls, whose curves have in most cases very short radii, which are most apt to produce a separation of the layers of which the tire is built.

"I am informed that the main cause of trouble now being experienced in New York is of this nature, and I believe that the strength of the materials used in the construction of the present pneumatic tire is being continually exceeded, and I base this opinion upon the curves given.

"Take, for example, a 36-inch wheel at 12 miles per hour, mounting an obstacle which would cause its axle to lift 3 inches; this blow or shock would be equal to a 30-pound weight falling 10 feet. Such a blow cannot help but produce injuries to the substance used in construction, which would be more or less destructive, depending upon the area of contact of the tire. If this area be small, a puncture is the result; if the area be great enough to prevent actual puncture, bruises are the result, which in time show themselves in a disintegration of the tire.

"I would also urge the desirability of making every effort to reduce the weight of the vehicle by abandoning the use of heavy castings."

Advantage Lies in Using Wheels of Large Diameter Rather than Tires of Accentuated Section

"On first looking into this subject I made a number of tests upon the motor in use on vehicles, as to its efficiencies, torque, speed, etc., under a number of varying conditions, and found that the curves, as submitted to us manufacturers, are substantially true.

"Two of these motors were then placed upon a hansom cab, and a number of road tests made over a standard route of varying grades, roadbeds, etc., the elevations of which route were taken from the city maps, and grades calculated therefrom.

"The following values of draw-bar pull were then deduced from the readings of volt, ampere and wattmeters, and a number of readings made with a dynamometer, while being towed north, then south, over the same roadbed.

"Readings of watt hours per 10 miles were also taken while running over average grades and roads in New York, and averaged about 150.

"The vehicle was at this time equipped with roller bearings throughout, 5-inch round pneumatic tires, and standard 36-inch wheels.

"See Chart, Fig. 6, of Approximate Values, which vary with the special conditions of equipment.

"On the above data I have given a table which may be used as a working basis, giving power required per ton at various *velocities* and *grades*. Corrections for wind and special conditions of running gear should be made in using this table.

"All these methods of tests seemed to give rather unsatisfactory and varying results, and they are subject to errors of a greater magnitude than the value of the effect which it was oftentimes desired to measure; therefore I finally adopted 'A Drifting Test,' in which the energy stored up, due to the motion and mass of the vehicle, expands itself in a time and through a space varying with the particular equipment of the vehicle as to bearing and running gear generally, and from which test the H. P. D. B. P. and watt hours per ton mile may be readily and accurately calculated by the most simple formula.

"Before going further I would analyze the effort to move an electric vehicle over a roadbed, as follows:

up at all exhaustively, but have considered only a certain few of those which were more pronounced.

"Referring to items by number:

"1. Motor curves, efficiency, etc., sensibly the same as submitted by the manufacturers.

"2. Motor bearings; not investigated closely.

"4. Gears; not closely investigated.

"5. Wheel bearings.

"Roller bearings of various kinds were tested. Several of these types of roller bearings are too light in their design, and mechanically are bad, the cages being too weak in their construction. I would recommend that the cages be made of one piece of steel fitting the rollers with very little clearance.

DRAW-BAR PULL AND HORSEPOWER PER TON

DRAW-BAR PULL = 375. × (.16 ± .0528 × % GRADE). T = 2000. lbs.

HORSEPOWER = M-br × T ($\frac{K}{375}$ ± .0528 × % GRADE) K = 60. lbs

"+" % GRADE	0.	.25	.5	.75	1.	1.5	2.	2.5	3.	3.5	4.	4.5	5.	5.5	6.	6.5	7.	7.5	8.	8.5	9.	10.	11.	12.	13.	14.	15.	%
DRAW-BAR PULL	60.	65.	70.	75.	80.	90.	100.	109.	119.	129.	139.	149.	159.	169.	179.	189.	199.	209.	219.	229.	239.	258.	278.	298.	318.	338.	357.	D.B.P.
SPEED.									HORSE POWER AT "%" GRADE																			SPEED
Miles per Hr.	Feet per Min.	Feet per Sec.																										Miles per Hr.
.5	44.	.73	.08	.086	.093	.10	.11	.12	.13	.15	.16	.17	.19	.20	.22	.23	.24	.25	.27	.28	.29	.31	.32	.34	.37	.40	.42	.45	.48	.5
.75	66.	1.10	.12	.130	.140	.15	.16	.18	.20	.22	.24	.26	.28	.30	.32	.34	.36	.38	.40	.42	.44	.46	.48	.52	.56	.60	.63	.68	.71	.75
1.	88.	1.46	.16	.173	.186	.20	.21	.24	.27	.29	.32	.35	.37	.40	.42	.45	.48	.50	.53	.56	.58	.61	.64	.69	.74	.79	.85	.90	.95	1.
1.5	113.	2.20	.24	.26	.279	.30	.32	.36	.40	.44	.48	.52	.56	.60	.64	.68	.72	.76	.80	.83	.88	.92	.95	1.03	1.11	1.19	1.27	1.35	1.43	1.5
2.	176.	2.94	.32	.35	.37	.40	.43	.48	.53	.58	.64	.69	.74	.80	.85	.90	.95	1.01	1.06	1.11	1.17	1.22	1.27	1.38	1.48	1.59	1 69	1.80	1.91	2.
2.5	220.	3.67	.40	.43	.47	.50	.53	.60	.67	.73	.80	.86	.92	1.00	1.06	1.12	1.19	1.26	1.32	1.39	1.46	1.52	1.59	1.72	1.85	1.99	2.13	2.25	2.38	2.5
3.	264.	4.40	.48	.52	.56	.60	.64	.72	.80	.88	.96	1 04	1.11	1.20	1.27	1.35	1.43	1.51	1.59	1.67	1.75	1.83	1.91	2.06	2.22	2.38	2.54	2.70	2.86	3.
3.5	308.	5.13	.56	.61	.65	.70	.75	.84	.93	1.02	1.12	1.21	1.30	1.40	1.48	1.58	1.67	1.76	1.85	1.95	2.04	2.12	2.22	2.41	2.59	2.78	2.96	3.15	3.33	3.5
4.	352.	5.87	.64	.69	.74	.80	.85	.96	1.06	1.17	1.27	1.38	1.48	1.60	1.70	1.80	1.91	2.02	2.12	2.22	2.33	2.44	2.55	2.75	2.96	3.18	3.38	3.60	3.81	4.
4.5	396.	6.60	.72	.78	.84	90	.96	1.08	1.20	1.31	1.43	1.55	1.67	1.80	1.91	2.03	2.14	2.27	2.38	2.50	2.62	2.74	2.86	3.10	3.34	3.57	3.81	4.05	4.29	4.5
5.	440.	7.34	.80	.87	.93	1.00	1.06	1.20	1.33	1.46	1.60	1.72	1.85	2.00	2.12	2.25	2.38	2.52	2.65	2.78	2.92	3.05	3.18	3.44	3.71	3.97	4.23	4.50	4.76	5.
5.5	484.	8.07	.88	.95	1.02	1.10	1.17	1.32	1.47	1.61	1.75	1.90	2.04	2.20	2.34	2.48	2.62	2.78	2.92	3.06	3.21	3.36	3.50	3.78	4.08	4.37	4.65	4.95	5.24	5.5
6.	528.	8.81	.96	1.04	1.12	1.20	1.28	1.44	1.60	1.75	1.91	2.07	2.23	2.40	2.55	2.70	2.86	3.03	3.18	3.34	3.50	3.66	3.82	4.13	4.44	4.77	5.08	5.40	5.72	6.
6.5	572.	9.54	1.04	1.13	1.21	1.30	1.38	1.57	1.73	1.90	2.07	2.24	2.41	2.60	2.76	2.93	3.10	3.28	3.44	3.61	3.79	3.96	4.13	4.47	4.82	5.16	5.50	5.85	6.19	6.5
7.	617.	10.26	1.12	1.21	1.30	1.40	1.49	1.68	1.86	2.04	2.24	2.42	2.60	2.80	2.97	3.15	3.34	3.53	3.71	3.89	4.08	4.27	4.45	4.82	5.18	5.56	5.92	6.30	6.67	7.
7.5	661.	11.00	1.20	1.30	1.40	1.50	1.60	1.80	2.00	2.19	2.40	2.59	2.78	3.00	3.18	3.38	3.58	3.78	3.98	4.17	4.37	4.58	4.77	5.17	5.56	5.96	6.34	6.75	7.14	7.5
8.	704.	11.73	1.28	1.38	1.49	1.60	1.70	1.92	2.13	2.34	2.35	2.76	2.96	3.20	3.40	3.60	3.81	4.03	4.23	4.44	4.67	4.88	5.08	5.51	5.93	6.35	6.77	7.20	7.62	8.
8.5	748.	12.45	1.36	1.47	1.58	1.70	1.81	2.04	2.26	2.48	2.71	2.93	3.15	3.40	3.61	3.83	4.05	4.28	4.51	4.72	4.96	5.18	5.41	5.85	6.29	6.73	7.19	7.65	8.10	8.5
9.	793.	13.20	1.44	1.56	1.67	1.80	1.92	2.16	2.40	2.63	2.87	3.10	3.34	3.60	3.82	4.05	4.28	4.53	4.77	5.00	5.25	5.49	5.72	6.19	6.67	7.14	7.61	8.10	8.59	9.
9.5	837.	13.90	1.52	1.64	1.77	1.90	2.02	2.28	2.53	2.78	3.03	3.28	3.52	3.80	4.03	4.28	4.52	4.79	5.03	5.27	5.54	5.80	6.03	6.53	7.03	7.54	8.04	8.55	9.05	9.5
10.	881.	14.60	1.60	1.73	1.86	2.00	2.13	2.40	2.66	2.92	3.19	3.45	3.71	3.98	4.24	4.51	4.77	5.04	5.30	5.56	5.83	6.10	6.36	6.88	7.41	7.94	8.47	9.00	9.53	10.
10.5	925.	15.40	1.68	1.82	1.95	2.10	2.24	2.52	2.80	3.07	3.35	3.62	3.90	4.20	4.45	4.73	5.01	5.29	5.57	5.83	6.12	6.41	6.67	7.22	7.78	8.34	8.88	9.45	10.0	10.5
11.	968.	16.14	1.76	1.90	2.05	2.20	2.34	2.64	2.93	3.21	3.50	3.80	4.08	4.40	4.67	4.95	5.24	5.55	5.83	6.12	6.42	6.72	7.00	7.57	8.15	8.74	9.31	9.90	10.5	11.
11.5	1012.	16.87	1.84	1.99	2.14	2.30	2.45	2.76	3.06	3.36	3.67	3.97	4.27	4.60	4.87	5.18	5.48	5.80	6.09	6.39	6.70	7.02	7.31	7.92	8.52	9.14	9.73	10.4	11.0	11.5
12.	1056	17.60	1.92	2.08	2.23	2.40	2.56	2.88	3.19	3.50	3.82	4.14	4.45	4.80	5.08	5.40	5.72	6.05	6.36	6.67	7.00	7.32	7.63	8.26	8.89	9.54	10.2	10.8	11.4	12.
12.5	1100.	18.35	2.00	2.16	2.32	2.50	2.66	3.00	3.33	3.65	3.98	4.32	4.63	5.00	5.30	5.62	5.97	6.30	6.62	6.95	7.28	7.63	7.95	8.61	9.27	9.94	10.6	11.2	11.9	12.5
13.	1145.	19.10	2.08	2.25	2.42	2.60	2.77	3.12	3.46	3.80	4.14	4.48	4.82	5.20	5.51	5.86	6.20	6.56	6.88	7.22	7.58	7.93	8.27	8.95	9.63	10.3	11.0	11.7	12.4	13.
13.5	1188.	19.80	2.16	2.34	2.51	2.70	2.88	3.24	3.59	3.94	4.30	4.66	5.00	5.40	5.72	6.08	6.43	6.81	7.15	7.51	7.87	8.24	8.58	9.29	10.0	10.7	11.4	12.2	12.8	13.5
14.	1232.	20.50	2.24	2.42	2.60	2.80	2.98	3.36	3.73	4.08	4.47	4.83	5.20	5.60	5.94	6.30	6.68	7.07	7.42	7.78	8.16	8.55	8.91	9.63	10.4	11.1	11.8	12.6	13.3	14.
14.5	1277.	21.30	2.32	2.51	2.70	2.90	3.09	3.48	3.86	4.23	4.62	5.00	5.38	5.80	6.15	6.52	6.92	7.32	7.68	8.07	8.45	8.85	9.23	9.98	10.7	11.5	12.3	13.1	13.8	14.5
15.	1321.	22.20	2.40	2.60	2.79	3.00	3.19	3.60	3.99	4.38	4.78	5.18	5.57	6.00	6.37	6.76	7.16	7.57	7.95	8.35	8.75	9.15	9.54	10.3	11.1	11.9	12.7	13.5	14.3	15.
15.5	1365.	22.70	2.48	2.68	2.88	3.10	3.30	3.72	4.13	4.52	4.94	5.34	5.75	6.20	6.57	6.96	7.39	7.82	8.21	8.62	9.04	9.46	9.86	10.7	11.5	12.3	13.1	14.0	14.8	15.5
16.	1409.	23.50	2.56	2.77	2.97	3.20	3.41	3.84	4.26	4.67	5.10	5.52	5.93	6.40	6.78	7.18	7 62	8.07	8.48	8.90	9.33	9.77	10.2	11.0	11.8	12.7	13.5	14.4	15.2	16.
16.5	1452.	24.20	2.64	2.86	3.07	3.30	3.51	3.96	4.40	4.82	5.27	5.68	6.12	6 60	7.00	7.41	7.87	8.32	8.75	9.18	9.62	10.0	10.5	11.4	12.2	13.1	14.0	14.8	15.7	16.5
17.	1500.	24.90	2.72	2.94	3.16	3 40	3.62	4.08	4.52	4.97	5.42	5.86	6.30	6 80	7.21	7.63	8.11	8.57	9.01	9.46	9.92	10.4	10.8	11.7	12.6	13.5	14.4	15.3	16.2	7.

"1. Energy delivered by battery and lost in motor (electrical).

"2. Friction of motor bearings.

"4. Friction of gears.

"5. Friction of wheel bearings.

"6. Traction effects between an uncemented tire and felloe.

"7. Traction effects between tread of tire and roadbed.

"A. Effect of chord of tread.

"AA. Effect of form of face of tread.

"B. Effect of material of tire.

"C. Effect on gases in tire.

"D. Work done on roadbed.

"8. Wind effect due to motion of vehicle (still air).

"9. Wind effect due to motion of air which may be favorable to or against vehicle.

"10. Effect of grades.

"11. Personal equation of the operator.

"A number of the minor effects noted above I have not taken

"Straight bronze sleeves gave 18 pounds per ton D. B. P.

"6. Traction effect between tire and felloe when uncemented. It is difficult to make a test of this kind, as valve is apt to shear off due to creeping of tire, which is very pronounced when tires are not inflated at high pressures.

"7. Effects between tire and roadbed.

"A. Chord of tread of tire measured at its surface on roadbed perpendicular to axis of wheel influences the traction effort (according to my interpretation of tests) for a 5-inch round or flat-tread pneumatic tire of 36-inch diameter, as:

"$C^2 \times .0281 =$ D. B. P. per ton due to this effect only when C = the sum of the chords of 4 wheels in inches. See Fig. 5.

"AA. The form of face of tread.

"When the tread of a tire is broad and flat it has the effect of reducing the chord of tread at the same air pressure, and consequently reduces the traction effort, or with the same chord the air pressure may be reduced, which materially reduces the burst-

ing stresses in the tire. These are both material advantages.

"B. The material of which the tire is built, particularly the quality of rubber, has a very marked influence upon the D. B. P. or traction effort, which appears in the form of heat developed in the substance of the tire, and for a high-grade rubber would be a favorable draw-bar pull.

"The above fact is confirmed by a representative of the tire-makers, who stated, upon inquiry, that in rolling rubber of high grade the rolls in from five to seven minutes became quite hot, and had to be kept cool by cold running water, whereas with tougher rubber the rolls have frequently to be heated by steam introduced into them.

"C. In referring to the work done on the gases contained within a tire, when a vehicle is in motion, I do not think that a very great quantity is absorbed by the gas, although I have not confirmed the opinion by experiment.

"These gases do, however, become heated, due to energy absorbed from the rubber, and the pressure is increased consequently .00366 per °C, that is pressure = 1 + .00366 × °C increase in temperature.

"A tire at the bottom may be inflated at say 100 lbs. at temperature of room (in summer) 32° C. Then we will assume that temperature increases due to work done on rubber = 14°C, and temperature due to the exposure to sun and rolling over hot pavements = say 10°C. Maximum pressure attained = say 110 above atmosphere.

"The bursting pressure in 5-inch pneumatic tires when inflated at 100 lbs. pressure equals 200 lbs. per linear inch of greater circumference, and about 100 lbs. per linear inch of smaller circumference.

"These forces tend to cause a tire to alter its form when inflated.

"In measuring up a 5-inch tire it was found to decrease in its greater (inner) diameter .62 inch, and a 5-inch round tire of another make decreased but .2 inch. This peculiarity is due to the material used in and to the construction of the respective tires. The side lugs of the first tire are less inclined to leak than those of the other, which is caused by the above fact, that is to say, the first tire grips rims when inflated, and there is little or no strain consequently on the lugs, whereas with the others the reverse is the case.

"In inflating tires an allowance of ten or fifteen pounds should be made by tripping valves.

"D. The work done on hard road beds such as are found in this city is, I think, inappreciable, but in running over soft country roads this would beeome a very important factor.

"It is my opinion that the stresses in a driving tire due to its transmitting the power to move a vehicle are not of a sufficient magnitude to produce any material distortion of its substance, and are consequently insufficient to absorb any appreciable amount of energy, being rarely over 60 pounds per ton on a level, which is distributed between two tires.

"8 and 9. Wind Effects.

"10. Grade Effects.

"11. Personal Equation of Operator.

"The operator often varies the watt hours per ten miles by 50 per cent. or more.

"From a mass of experimental data the conclusions that are to be drawn must be classified so that the points which do not offend reason may be brought into relief, and the information that seems to have value with its conclusion obscured, may be kept in sight with the hope that further investigation will render the subject-matter clear. Of the things that show plainly in this investigation, it is quite evident that tire diameter is uppermost, and it may be assumed from what has been said, that it is entirely wrong to keep on increasing the section of the tire, maintaining a constant diameter. Moreover, in advocating that tires be kept in a fully inflated state, it must be borne in mind that the term 'full inflation' has to do with a very definite pressure that must be disposed of in some more exact way than merely to inflate until the tire stands up under the load."

Approximate Conclusions That May Be Summed Up from an Examination of the Investigation as Thus Far Conducted

It was shown in THE AUTOMOBILE in previous efforts that a tire will not stand up under the load unless it is of a certain size in view of the static load imposed. But the work that tires have to do under service conditions cannot be classified as static. It follows that a static test will show if the tire is entirely too small to be considered from any point of view, but when this phase of the problem is disposed of, it still remains to find out whether or not the tire is big enough to satisfy the conditions of road work. It is in this part of the undertaking that the experiments show how futile it is to merely increase the section diameter of the tire for no better reason than to get around the fact that the wheel diameter is insufficient for the purpose.

From the draw-bar pull point of view as it relates to the air pressure in the tires, Fig. 7 discloses information which goes to show that the amount of power absorbed in the tires is a wide variable depending upon the condition of inflation for a given size of tire, and of course the power required to propel the automobile increases with the draw-bar pull. In this case, using a 4-inch flat tread, 5-inch Diamond pneumatic tire, with 30 pounds per square inch the draw-bar pull was approximately 34 on the scale, whereas with 60 pounds pressure the draw-bar pull dropped to approximately 8 on the scale. The scale of abscissæ on this chart is given in terms of draw-bar pull (D. B. P.) equals the draw-bar pull in pounds divided by 2,000. In any tire the relation of draw-bar pull to air pressure will be a good index of whether or not the tire is properly applied to the car on which it rolls, since the draw-bar pull will increase unduly if the tire is inappropriately applied, and experiments along this line should show something worth while.

In discussing the problem of excess flexure the reasons for this type of deformation may be assigned to two classes, (a) if the tire is of the right diameter, but insufficiently inflated, and (b) if the tire is too small in diameter, and inflated to its limit. The life of the tire of the right diameter, even if it is running "soft," will far exceed the life of the relatively small tire when it is inflated to its maximum, and it goes without saying that the life of the mechanism of the automobile will be maximum with the large-diameter tire running soft.

It is obvious that any undue weight of the automobile will mark an increase in tire depreciation that is not to be justified either on the ground that castings are cheap and easy to get, or on the assumption that a heavy automobile will have an easy motion on a rough road under conditions of high speed. It is probably true that there is a relation between the weight of the automobile and the speed on the road that it can be made to travel under conditions of easy riding. Practice shows that a heavy automobile, if the mass is properly distributed, may be run at a high speed, and the occupants of the car will experience a certain amount of pleasure. The tire bill, however, will be high, due to the use of wheels of an insufficient diameter, and the cost of operation, all things considered, represents an economic fallacy. There is nothing to prevent the reaching of the conclusion that relatively light-weight automobiles, if the mass is properly distributed, will have a marked influence in favor of small tire bills, and as the investigator pointed out in his presentation, the moment of inertia of the automobile must be regulated.

WHEN A LAMP GLASS BREAKS.—When the tail-lamp glass breaks, red tissue paper bought from a stationery or toy store can be substituted, the paper being either tied round the lamp with string or fitted into the frame which held the glass.

Conserving Tires--Maker's Problem

Discussing Evils of Inappropriate Tire Applications

Relating how automobiles may be designed so that they will roll around the corner with the same ease that they traverse a tangent. Joseph Schaeffers presents the mathematics of the steering mechanism involving the canting of the front road wheels, and the tabulation from the point of view of wheel-base length and canting angle is given as a résumé of the analytical undertaking.

MYSTERY and its twin, superstition, engage the minds of automobilists while the tires on their automobiles wear out. If it is a conspiracy, and the tires desiring to wear out enlist the services of these mighty generals, mystery and superstition, it is conceded that the plan of battle is well thought out, and the users of automobiles will have to awaken from their lethargy, or heavy drafts will be made upon the contents of their purses, as a war indemnity. at the brisk demand of the tire situation.

There is no place for mystery and superstition in the tire problem, and these gentry should be smoked out. When a well-made automobile traverses a hard level road on a tangent at a reasonable speed, if the tires are big enough for the car, and they are inflated to the critical point, they last for a long while. In going around corners, there are two conditions of the negotiation, one of which has to do with the rear wheel performance, involving the differential gear which is placed to permit the wheels to rotate at different speeds delivering power in a ratio to correspond, and the remaining consideration is the one that is receiving attention here, involving the turning of the automobile around corners, so canting the wheels that rolling motion will be imparted to them respectively.

In Copying Existing Examples of Steering Gears Draftsmen Perpetuate the Mistakes That Were Made in the Effort That They Look Upon as a Shining Example of Automobile Acumen

It is not uncommon to observe cars that are designed so that the front wheels rotate on their pivots in such a relation as to maintain parallelism of the wheels to each other when the automobiles are traversing a tangent, but the design frequently fails to accord with the further necessary condition, since in making turns the center lines of the front wheels form an angle which does not coincide with the centers of the rear wheels, whereas in good practice each wheel of the automobile rolls on a circle, the radius of which has its axis at M.

It is believed that the most conspicuous failures in designing steering equipment are the product of draftsmen who copy what they see, either because they are incompetent, counting indolence as the most conspicuous example of incompetence, or because they have such high respect for the designers who originated mistakes that they take them as examples to go by, with the result that these draftsmen measure the length and offset of the steering knuckle of the cars that attract their notice, and the dimensions so obtained are used on the theory that they must be right because the automobiles that represent them run, although no investigation is made to ascertain the size of the tire bill that has to be paid to keep such automobiles on the road.

Referring to Fig. 1 it is indicated that the center line of the steering knuckles meet on the center line of the car in point A. In order to obtain the best results from a steering system of this type, the distance between A and the front axle, *i. e.*, X has to be made a function of L, the wheelbase, B the distance between knuckle-centers, and β max. the greatest possible inclination of the inner front wheel when turning the smallest possible radius. In common practice, which is not to be sanctioned, $X = L$, or $X = 2/3\ L$, or $X = 3/5\ L$.

As a rule, designers make no difference between the front trapeze and the rear trapeze, *i. e.*, the angle ϕ is fixed in some manner and used alike for cars with the cross-rod between steering knuckles in front of the front axle or back of it, and the same steering knuckles, *i. e.*, also the same angle ϕ is used for varying wheelbases, the writer having found instances where for various chassis lengths with the wheelbase running from 105 to 140 inches the same set of knuckles is being used.

In some instances the steering mechanism is laid out on the drawing board and ϕ fixed, so that the center lines of the front wheels meet in one point (M) on the center line of the rear wheels at the greatest possible inclination of the inner front wheel. In this case the wheels run correctly when driving in a straight line and when turning the smallest possible curve. At all intermediate curves this design will be found faulty and causing considerable tire wear.

Taking as standard values

$$\frac{L}{B}\ \text{minimum} = 1.5$$

$$\frac{L}{B}\ \text{maximum} = 3$$

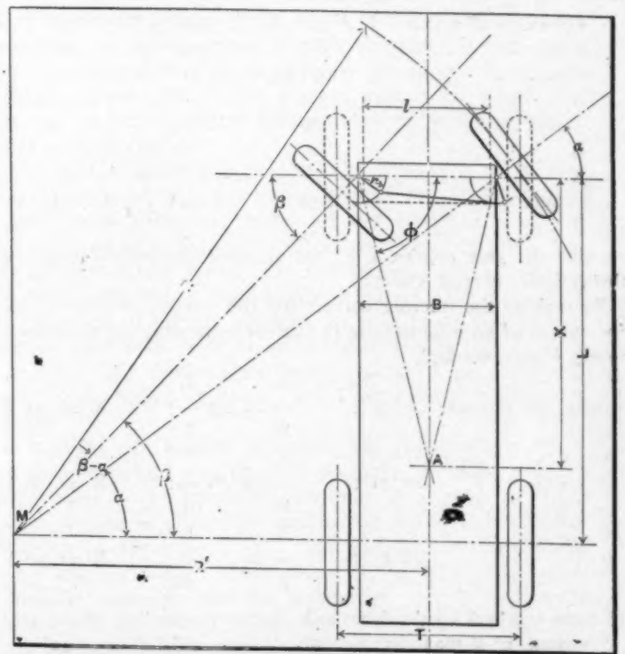


Fig. 1—Diagrammatic presentation of a theoretical automobile turning around a corner, indicating the mathematical relation between the length of the wheel base, the turning radius, and the canting angle of the road wheels

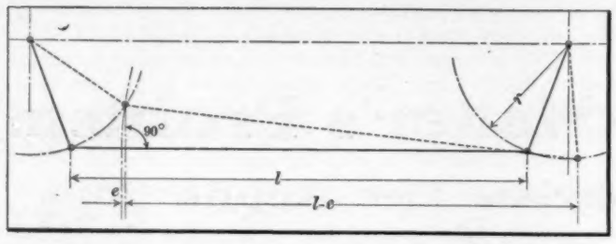


Fig. 2—Diagrammatic presentation of the front steering knuckle relations, bringing out the magnitude of the error as shown

and

α max. $= \beta = 35°$ for touring cars,
$= 40°$ for town cars, taxicabs and freight automobiles.
$= 45°$ in extreme cases,

we find

$\phi = 55°$ to be unsuitable,

$\phi = 80°$ also unsuitable even for maximum $\frac{L}{B}$.

The angle ϕ then has to be above 55° and below 80°. Small values for $\frac{L}{B}$ (short wheelbase) and large inclinations of the front wheel (ϕ max. = 54°) have an unfavorable influence upon the proper function of the steering mechanism.

Fig. 2 shows the amount of the error e which has to be taken care of in such a way as to do the least possible damage. It is obvious then, that e decreases with increasing l and decreasing r. On the other hand, l is usually fixed by the design of the car, and r cannot be made too small or the strain upon the cross-rod and the knuckle levers would assume undesirable proportions, besides giving too marked effect to any play that may develop in the cross-rod ties and pins.

The scheme as shown in Fig. 3 with offset knuckle spindles O_1 and O_2 tends to somewhat improve the situation and has therefore been adopted by designers.

Fixing 1.5 as low, and 2.5 as high limit for $\frac{L}{B}$ we find if cross-rod in front of front axle:

α max. $= \beta$ max. =	35°	40°	45°
ϕ min. =	58°	59°	60°
ϕ max. =	69° 30′	71°	72°
$\frac{X}{B}$ min. =	.80	.84	.90
$\frac{X}{B}$ max. =	1.30	1.40	1.50

to give the best results, *i. e.*, the smallest deviations from the theoretically correct system.

By making the steering correct for the straight line drive and for curves of an intermediate radius corresponding approximately to 2/3 α max. we find,

α max. $= \beta$ max. $= 35°$; $\frac{X}{B} = .53 \frac{L}{B}$; $X = .53\ L$

$= 40°$; $\frac{X}{B} = .56 \frac{L}{B}$; $X = .56\ L$

$= 45°$; $\frac{X}{B} = .60 \frac{L}{B}$; $X = .60\ L$

If cross-rod back of the front axle, the corresponding values are:

α max. $= \beta$ max. =	35°	40°	45°
ϕ min. =	60°	67°	68°
ϕ max. =	74° 30′	75°	76° 30′
$\frac{X}{B}$ min. =	1.12	1.17	1.26
$\frac{X}{B}$ max. =	1.79	1.86	2.00

and further,

α max. $= \beta$ max. $= 35°$; $\frac{X}{B} = .13 + .68 \frac{L}{B}$

$= 40°$; $\frac{X}{B} = .145 + .69 \frac{L}{B}$

$= 45°$; $\frac{X}{B} = .155 + .75 \frac{L}{B}$

With these values it will be found that the maximum deviations from the theoretically correct steering are so small, that the elasticity and resiliency of the tire overcome what little gliding friction there does occur. Of course, every unevenness in the road, every shock and jar tends to influence the correct working of the steering system by bringing the cross-rod out of its horizontal position, but these deviations are also inconsiderable.

The following tabulation gives the radius R of the smallest possible curve for cars when T = 56″, B = 50″ and varying wheelbase from 100″ to 150″ for α max. $= \beta$ max. = 35° and = 40° and = 45°. Taking R minimum as given,

α max. $= \beta$ max. =	35°	40°	45°
Wheelbase = 100″	18′ 6″	16′ 10″	15′ 6″
= 105″	19′ 2″	17′ 6″	16′ 1″
= 110″	19′ 11″	18′ 1″	16′ 8″
= 115″	20′ 8″	18′ 9″	17′ 3″
= 120″	21′ 4″	19′ 5″	17′ 10″
= 125″	22′	20′ 1″	18′ 5″
= 130″	22′ 9″	20′ 8″	19′
= 135″	23′ 6″	21′ 4″	19′ 7″
= 140″	24′ 3″	22′	20′ 3″
= 145″	25′	22′ 8″	20′ 10″
= 150″	25′ 9″	23′ 4″	21′ 5″

Fancy Is a Non-Successful Dictator

The indiscriminate use of tires of various shapes on different makes of automobiles is to be deprecated on the ground that all shapes of the threads are not of equal efficiency under a fixed set of conditions. Some tires are built to work under heavy loads at moderate speeds, and other tires are made to survive the wiles of racing conditions, between which limits there are a considerable number of styles of treads that suffer or survive according to the conditions imposed. In the face of this wide range of possibilities the users of automobiles buy tires on a basis of some unproven theory, or with an eye to art.

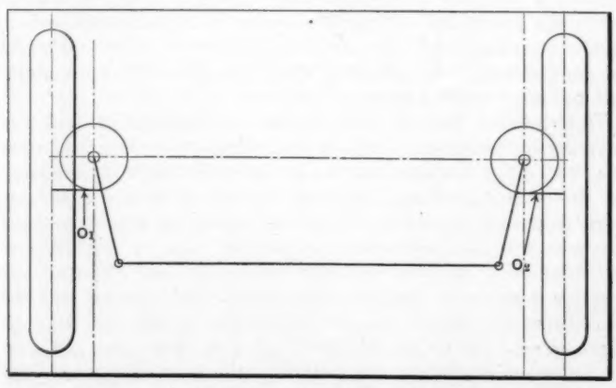


Fig. 3—Presenting an offset knuckle spindle which is offered as an improvement over the condition as depicted in Fig. 2

Ambition Is for Better Tire Results

Thought Strays from the Path of Rectitude

A rather broad assertion on the trend of the tire situation, suggesting that ambition is master and that thought must be controlled. From the point of view of users of automobiles it is feared that thought is under a spell every minute that they labor under the impression that tire bills are a necessary evil to the pleasure of automobiling. To realize the fullest measure of return for effort it is suggested that ambition should drive thought away from the morbid and allow a healthy glow to bloom on its damask cheek.

MISTAKING thought for its master (ambition), calling it a mysterious power, a modern publicist in a learned discourse said many things that, however true, were not the progeny of thought, but the wages of ambition.

Thought is a servant of whom it may be said he is the most thoughtless being imaginable. Of all the extravagant beings of earth, there are none so wasteful as thought. Instead of getting up early in the morning, partaking of a frugal repast, and going to work, thought lies abed and dreams of the things that will never happen, that never can happen and that would benefit the world and mankind but little if they did come to pass. But ambition, what of it? It awakens thought and drives it forth to search for the missing link in the chain of events that is to make its master realize its ideal.

Ambition must be satisfied, and yet it is the most dissatisfied of beings. Between dissatisfied ambition and its servant, thoughtless thought, the world goes slow, ideals perish and history records but a few doings that find lodgment on its pages.

When ambition is satisfied it must be due to one of two things, viz., its frugal wants awaken no envious competitor, or its servant thought betakes himself to definitely assigned tasks, wasting no hour unless to recuperate the jaded energies for better attack of the task that ambition assigns.

It is a common saying: "Conserve the energies!" Why bother with trifles, pray? Is it not true that energy a-plenty habitates each sack of wheat in bulging granaries? Must man conserve his energies in order that he shall more capably compete with draught animals?

Ambition says, "Not so!" Thought says, "Let us think it over together!" Who wins? Shall ambition's mandate be stilled by the flightiness of thought? It is the very catastrophe that overtakes failure on each occasion that works the downfall of the man who admits failure. But the successes. What of them? The master hand of ambition disciplines unruly thought and drives him forth to pluck the young buds of wisdom, and as they are gathered and cured a tea is brewed, and it is of this beverage that ambition sips as it occupies its round on the ladder of fame.

Let there be a famine of the crop! Let thought wander from his task! Allow the beggar to split up his energies and spread them like a gossamer web o'er the battlefield of life, when lo! merit and his caravan will form a brood and escape; ambition will tumble down and her bruised being, all huddled up at the bottom round of the ladder of fame, may never rise again.

What gross extravagance is thought! Just to think of it; this indefatigable being in man maintains a never-ceasing activity from the time of awakening at the dawn of day until the hour of sleep, and in all that time of the 90,000,000 thinking machines in this land not one evolves an original idea in a century.

Of the ambitions that are crushed due to the vagaries of thought there is no record, but of the pearly thoughts that raise man up there is a record. The reason for this lies in the sparse count of the pearls and the lack of any difficulty in counting them.

It is a habit of thought to be satisfied with any new ground that it may burrow into; evidently it throws dust in its own eyes, and with self-satisfaction it lulls its being into a dream-like slumber. Unless the taskmaster, ambition, cracks the whip around the ears of the sleeper he will slumber on in his blissful ignorance, allowing ambition to sit on a nest of decaying thought-eggs, and the latter, poor being if she is not alert, will dwell upon the eagles that she is going to hatch out until a day comes when the stench reaches her nostrils and she departs from the nest with a mangled will.

Of thoughts, let it be understood, they are flowing as a raging torrent, from flood gates that have stood ajar through aeons of time.

Of ambition, of the type that is easily subdued, the world has its pyramids, and, if crushed, ambition at least has the virtue of having fallen from a great height.

Thought Has a Habit of Straying Away with Good Tire Ideas and Losing Them—Ambition Favors a Better Plan

The best proof of the recklessness of thought will be found in the tire business. Of the thousands of expressions of thought that have passed current long enough to deceive participants there is but a dim record; it would take a thick book to record them all! The work that has been done on mechanical equivalents of pneumatic tires, in other words, spring wheels, however monumental and futile, represent stray thought—nothing more. Scientific investigation, such as ambition favors, would point to the fallacy of the plan of the average mechanical contrivance that is used in the making of spring wheels without a stroke of work or a dollar of cost.

In the field of pneumatic tires, of the thousands of failures that are on record, it is plain that thought has held the reins and driven with a reckless hand. Of the pneumatic tires that have made a name to conjure by, it is assured that ambition was at the bottom of the effort. But the ambition of the user of automobiles, considering him broadly, is not to point with pride to the largeness of the tire industry; he is in hopes that he may ultimately point with pride to his automobile—the idea is to be able to say: "My automobile is helpful to me; I get enjoyment from it; profit resides in its use, and I am a better citizen, due to its use."

The thought of "cashing in" while the opportunity affords, which thought is harbored by quite a number of those who occupy positions in the automobile business, is a poor one from the point of view of utility; the problem of economics was never worked out by the type of man who is most concerned about how to "get his"! The classification of the type of mistakes that thought scattered into the making of tires is nothing as compared with the errors of judgment that users indulge in—thought controls these errors and it remains for the users of automobiles to awaken ambition, drive it forth and tell it to make thought mind.

Used Automobiles Confront Dealers

How to Sell Cars for Cash Is the Problem

The inventor of the horse-trading art must have sold his patent right to the automobile industry, or some other equally fatal malady must have crept into the being of the users of automobiles according to this story, and the practice of taking worn-out automobiles as a large part of the consideration in the purchase of new cars is the basis of discussion, leading up to a somewhat extended plan, which has for its foundation the idea that money is what the makers of automobiles must get for their cars.

FIXING the selling prices of automobiles on a basis of equity requires that the items be classified, including, (a) the cost of material plus 10 per cent.; (b) the cost of labor plus "overhead"; (c) the cost of advertising; (d) the cost of demonstrating and selling; (e) the cost of teaching customers how to get a return on their investment; (f) the cost of ill-advised dealings, such as may be traced to competitive abuses, or the supine methods that come from having a bath towel spine; and (g) profit.

The difference between theory and practice is of considerable magnitude, at least in the automobile business; theoretically, in counting the cost to get the selling price of automobiles it is not necessary to allow for competitive abuses, and the leaks which abound in the absence of a plan. As a matter of cold hard fact, in the practice that obtains in the automobile business, the cost to the makers that may be directly traced to selling abuses is a large percentage of the total selling price, and, unfortunately, this extra item of cost is eating the profits of the business, and there are users of automobiles who labor under the false impression that they obtain a considerable and direct benefit as a result.

It is a short-sighted policy on the part of the purchaser of an automobile who insists upon getting a new car for a few dollars, including his old "junk pile," a pair of shoes and a decrepit lamp. The makers of automobiles will not be able to meet their pay-roll with "junkers," shoes and lamps—the workmen in the shops do not seem to be accommodating. But if workmen are exacting when they line up in front of the pay office, they are no whit more so than the vendors of steel, castings for cylinders, aluminum products, body work, or tires—they all want coin of the realm.

There is no evidence available of a substantial character that will show conclusively that makers of automobiles are reaping a harvest of reward; dividends are meager in many cases, paper in some instances, substantial in the places where the managing director's head is poised on one extremity of a real backbone, and vanishing for the rest.

It Spells Destruction to Incur a Fixed Cost and Put Up with a Variable Selling Price, Taking Part of the Latter in Worn-Out Automobiles

Referring again to the purchaser, if he participates willingly in a plan that will give him a good automobile in the first instance, and a bankrupt maker as his sole reliance when he wants repair parts, he abandons his investment to the wiles of chance, and he is the loser by the difference between an automobile that can be maintained, paying for its keep, and justifying its existence, and a car that will stand as a dead loss, excepting for two years' service.

Placing the responsibility for the poor plan that seems to rest contentedly in the being of the automobile art is a difficult thing to do. The makers of cars appoint agents of the class who are willing to pay a deposit on each car ordered, paying the balance cash on bill of lading. It would appear on the face of this plan as if the makers of automobiles are adequately protected, and it would seem to be the duty of the dealers, under the circumstances, to hunt around for success.

The face of this plan is not to be described as frank. True, the dealers must gather a harvest of success, or go to the wall. They are busying themselves in the undertaking, but the going is bad, the speed is high, and the non-skid chains are making a poor record to abide by, so that the wall is uncomfortably close. The reason for this unfortunate state of affairs may be traced to two things, one of which is beyond the control of the dealers and has to do with the fairness of the makers. It is not unusual in these days to discover that dealers are not protected in their territory, and makers of automobiles, after they get a deposit from their duly accredited dealers, appoint a sub-agent in the person of every citizen who is willing to buy a car, and these makers know perfectly well that all such citizens are mere buyers of automobiles, who should be compelled to go to the duly accredited representative of the maker in the district in which they reside. In the meantime, the dealer must say "good morning" to the rent man on the first day of every month; he must say "how-do-you-do" to the electric lighting bill when it comes in, and it keeps its appointment with the precision of the tick of time; the dealer must replace the tires that are worn out in making demonstrations, take the automobiles as they come from the works and tune them up, and do all of the other things that will attract the attention of the buying public for the making of a favorable impression.

The Foundation of the Structure Must Be Revamped—The Dealer Is Not the Man to Undertake the Reform

How a dealer can face his obligations, considering the burden that the makers unload upon him, if he accepts second-hand automobiles in part payment for new cars, it is impossible to say. The idea that the makers of automobiles are not concerned about this matter is too short-sighted to pass current. If a dealer signs up for 500 automobiles, and he goes to the wall before the half of them are sold, the maker will have 250 automobiles on his hands to dispose of after the selling season disappears. The profit on the output of the plant will be shattered by the blow that this failure will deliver, and the reputation of the maker will awaken on a gloomy day, and, arising from its bed of insecurity, it will go in quest of a bath of immunity, and it will go in vain.

In putting out a fire it must be split into wings, and each wing must be attacked separately with quenching fluid. In the natural course the fire of trouble that confronts the automobile situation has its classifications of inflaming material, and the taking of second-hand automobiles as part payment for new cars is the main topic. Granting that it is a makers' problem to cope with this evil, it may be conceded that no one maker should be encumbered by the enormous effort, and the next step, if logic is to abide in the concept, suggests that a plurality of makers participate in concert—why not all of the makers?

It is not the purpose here to infer that all of the makers of

automobiles should join hands in the manufacturing problem. The individual companies should enjoy the advantages of their acumen and enterprise unmolested by the restraint that necessarily follows concerted action, but the very acumen that suggests the desirability of freedom in the manufacture and exploitation of product points to the necessity of concerted action for the purpose of suppressing evils of the type that are so overpowering in their strength as to render the individual effort futile.

It would take a man of some stamina to manage the second-hand business jointly for all of the makers of automobiles; he would have to tell the dealers, through accepted channels, that they must not induce an owner of a car that is capable of service to get rid of it for no better purpose than to buy another automobile. He would have to decide whether or not the second-hand automobiles as they come to him are to be repaired and resold, or to be scrapped. As an undertaking it would mean that the better part of 100,000 automobiles would pass through his hands within the next two seasons, and it probably would be for the good of the automobile business were 50,000 of these automobiles scrapped, rather with the expectation that the remaining number might be repaired and resold, and that the profits accruing from this part of the enterprise would cover the cost of the scrapping of 50,000 cars, and the makers of automobiles would then create for themselves a market for 50,000 automobiles on a clean and wholesome basis.

The users of cars, under a comprehensive plan, would be placed in a position to realize an equitable value on their worn-out automobiles; they would not have to dicker with salesmen on a horse-trading basis, and the selling establishments of the various makers would be freed from the thraldom of tinkering with the selling price.

In the Execution of a Plan the Many Ramifications Will Have to Bear Witness to an Exacting Effort

It is timely to make the point that an unstable selling price, when it has to do with a commodity that is not absolutely necessary to purchasers, depresses the volume of business in proportion as doubt creeps in. Automobiles are not absolutely necessary to purchasers, that is to say, a man does not have to buy a car to-day, to-morrow or next week; a reasonably patient citizen can wait until next summer. If there is any question about the selling price, the average citizen will wait, and he will wait until he is satisfied that his money will bring him just as much automobile value as the same amount of money in the hands of some other citizen. It is a great mistake, under these conditions, to inject uncertainty into the selling department, and on the face of it, if second-hand automobiles are accepted in part payment for new cars, the selling price cannot be fixed, due to the fact that no two second-hand automobiles can be of exactly the same value, and chance is the biggest element in the whole proceeding.

Instantly the mind touches upon the executive side of the used-car problem, the ghosts of a hundred troubles bob up serenely. It is hard to relate the process by which all the makers of automobiles will consent to join each other in an issue that will have for its purpose the alleviation of the used-car problem. Perhaps the enormity of this problem can be illustrated in a very simple way. In Kentucky, family feuds are fierce and war-like; the various wings of families disagree upon many points, and they fight their battles and win their way without a thought of accepting the assistance that one branch might readily extend to another were they a little more neighborly than their reputation seems to indicate. But if the head of one wing of a family dies they will all join hands in the fitting burial of the deceased, which goes to show that they only disagree in their prosperity, and they join issues in their misery.

The misery end of the automobile business is all that this subject is intended to cover, and if the fierce brand of mountaineers can bury the hatchet long enough to help at the obsequies of a fallen enemy, why should the makers of automobiles balk at the mere matter of entering into a relation that will suppress misery, give an impetus to progress, wipe out the greatest obstacle to the furtherance of the automobile business, and make provision whereby the customers of the trade will know the value of a name-plate after the car that bears it becomes too rickety to continue in service?

It requires no further argument to show that the makers of automobiles will be justified in burying the hatchet if it gets in the way of success, and it has been said that the second-hand problem can be handled without infringing upon the enjoyment of liberty in the building and exploitation of new automobiles, leaving it to some man of caliber to work out the details of the method that must ultimately come, so that the purchasers of automobiles will know when they buy any one of the many makes of cars that no agent will come around and try to induce them to part with an automobile before it is worn out, but that the name-plate of the car will be worth a certain percentage of the original purchase price, and that the purchase price of a new automobile will be that as indicated in the literature of the maker, in other words, the list price.

In considering the details of this plan, assuming that 100,000 automobiles will have to be replaced within the next two seasons, remembering that the average selling price of the automobiles made during 1910 was in the neighborhood of $1,600, assuming that the name-plate of a worn-out automobile is worth 30 per cent., it means that the purchaser, considering an average case, would get $480 for his car from the second-hand mart, and that he could take his choice between taking $480, and keeping the car.

Continuing the discussion on a basis of 100,000 automobiles to be handled, it might be inferred that the director of this undertaking would be able to salvage 50,000, and that by overhauling them, getting repair parts from the respective makers, the average value of these automobiles would be increased to double the name-plate value of the worn-out automobiles, so that those who are willing to ride in second-hand automobiles could get one for $960 as an average proposition, and it is not too much to expect that the 50,000 automobiles so repaired and sold would pay for the handling of the 100,000 automobiles, one-half of which could be scrapped, and the makers of automobiles would benefit by this plan, (a) by creating a market for 50,000 new automobiles, (b) by removing from the market 100,000 automobiles, thus saving the automobile reputation, and (c) by furnishing the repair parts that would go into the 50,000 revamped cars.

Service Departments in the Many Centers Would Combine for Effective Work, Reaping Economies as a Direct Result

The advantages as above recounted are in addition to the main question. The principal idea is to be able to sell new automobiles for money rather than to take some money and an old car. The fact that an agent might have good judgment and turn an honest penny by making a good "horse trade," is not a good foundation for the continuing of the upsetting conditions that are creeping in as the direct result of the second-hand car complication. Moreover, if an agent takes a second-hand automobile in trade he must take time to sell that car, and even if he reaps an apparent profit, it stands as a dead loss, due to the fact that a second-hand automobile is harder to sell than a new car of reputation, and the agent who is compelled to shut down his new work while he devotes himself to the selling of a second-hand car is eating up his customers and his time, and the maker who relies upon him for result is being eaten up by overhead charges, whereas if the agent would sell the output in a timely way, the cost of building the automobiles would be reduced because of their prompt movement, which can only be traced to the diligent effort of the type of agent who confines himself to the work in hand, and declines to be flagged by a second-hand automobile.

The millions of dollars that are being put into service departments all over the country sap the vitality of the automobile business because they absorb capital, which is devoted to "salvage," instead of to the manufacturing of automobiles. In the insurance world, the salvage corps is looked upon as a necessary evil, but as an evil it is supervised and suppressed to the lowest working limit. Moreover, the insurance companies take a loss with equanimity rather than to take overmuch time in adjusting claims. That the insurance companies display wisdom is proven by their success. In the automobile business, the idea of having an enormous salvage corps is abhorrent from the economic point of view, for the very simple reason that it is "truckling in swill." The same idea is depicted in the plan whereby the crumbs that fall from the rich man's table are gathered up, in other words salvaged, for the benefit of the fellow whose energies are at such a low ebb that he considers himself in good business subsisting upon the crumbs. Utilizing this old-fashioned illustration just a little further, it requires no acumen in arriving at the conclusion that the man who is satisfied to feed on crumbs would be worth more money to the community were he compelled to go to work. The good of the automobile industry is in precisely the same fix. The thing to do is to build new automobiles to supply the demand, and after they are worn out in legitimate service, they must be reduced to raw material by the scrapping process, and everything points to the absolute necessity of concerted action on the part of the only men who can control the situation, which will give to the users of cars the service for which they pay, and to the makers of automobiles cash for their output.

American Cars Abroad

Statistics show that with each succeeding year the automobile manufacturers of this country increase their exportations over 50 per cent., the gain in 1910 over the previous year being nearly 70 per cent.

THE increase in the sale of American-made automobiles and parts to customers in foreign countries during the last three years has been something remarkable, as the official statistics of exports show. The ensuing table gives the result:

Nation.	1910.	1909.	1908.
Canada	$5,021,043	$2,437,042	$1,115,540
United Kingdom	2,755,592	2,059,210	1,728,704
Scattering, Europe	764,463	335,675	217,172
France	753,204	846,136	360,449
British Oceania	748,933	304,452	87,543
Mexico	689,903	494,238	312,603
Scattering Asia, etc.	599,756	191,448	129,968
South America	519,160	240,453	126,285
West Indies	412,588	337,414	198,078
Italy	377,570	224,068	248,519
Germany	331,754	181,087	158,979
Other countries	216,150	136,394	64,754
Total	$13,190,296	$7,786,617	$4,948,594

The grand total of automobiles and parts is thus shown to have been $25,925,186 within the period of three years.

The trend of events points to the future better understanding of the radiator problem and to the fact that carbon is formed in the combustion chamber of the motor if the radiator fails to do its part.

Heavy Springs vs. Deep Cushions

The Problem Is to Prevent the Breakage of Springs

Illustrating a type of automobile with 24-inch cushions on the seats, the idea being to impart initial suppleness to the seat proper, and to extend an extra measure of rigidity into the chassis springs in order to prevent spring breakage, through the simple expedient of using enough material in the springs to keep them from wearing out too soon.

MAKERS of automobiles find it extremely difficult to prevent chassis springs from breaking, notwithstanding the use of alloy steel, and the employment of every device in the heat-treatment field, to induce in the materials of which springs are made the fine qualities that will enable them to persist under the rigors of their exacting service. Resort is made to the principle of the long pendulum in the designing of springs,

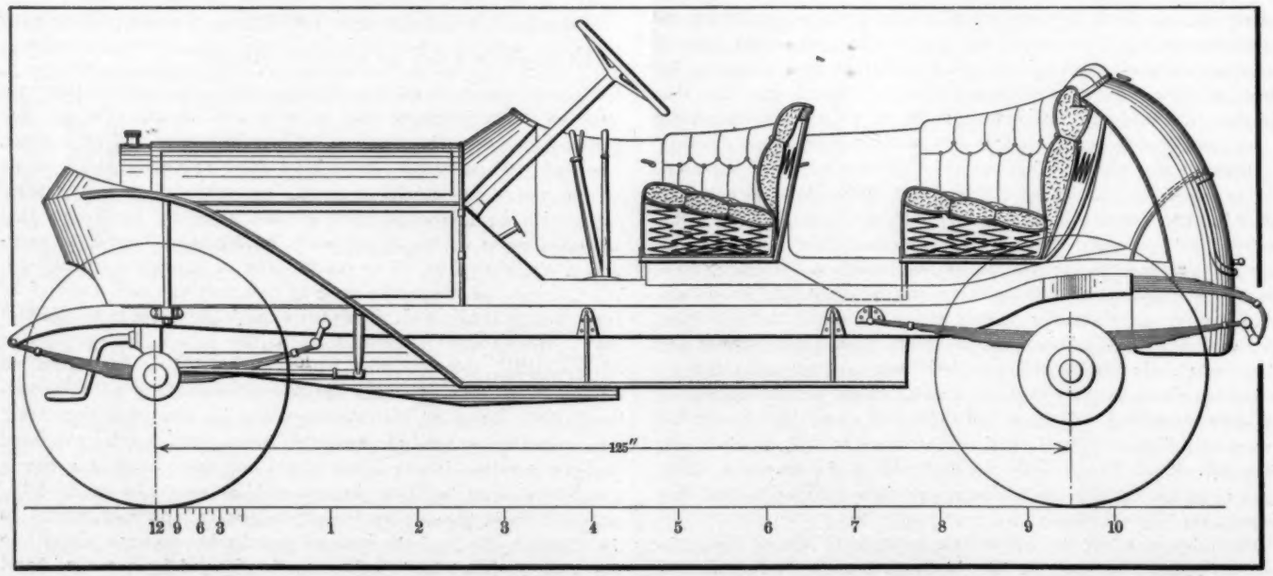


Fig. 1—Side elevation in part section of a touring body of the deep-cushion type, suggesting the use of stout springs on which to suspend the chassis

and enough material is put into them to assure the proper clearance between the side bars and the axle under the conditions of static loading, whereas for the rest, dependence is placed upon fine grades of steel to handle the kinetic work.

But a good spring is only to be had if the fiber strain in the section of the metal is close to the elastic limit, that is to say, if sole reliance is put in the springs to induce the conditions of easy riding qualities. Under these conditions, the springs cannot last for a long time, since steel, if it is flexed to a point approaching its elastic limit, will fall a victim to fatigue, and the crystalline structure that is born during the period of undue flexure is too treacherous to be tolerated in a high powered high speed automobile. The first remedy that suggests itself to the designer is the use of an extra measure of material, bringing the pounds of steel per foot of energy up to a more equitable level. But in thus proceeding, it is a clear departure from easy riding qualities, and the poor performance of a "lumber wagon" is all that can be realized if this route is taken in the quest for success.

An excellent way of satisfying the conditions for easy riding without stinting the springs comes with the use of deep cushions as shown in Fig. 1, the side of the body being cut away with the seats sectioned to bring the construction of the cushions of the seat into view. These cushions are 24 inches deep, and in addition to being padded, a nest of spiral springs are used, so that the initial suppleness that is ordinarily to be expected from the springs that support the chassis resides in the construction of the cushions. By thus proceeding, it is found possible to add a considerable amount of material to the chassis springs, thus taking them out of the zone where crystallization and failure hovers around, and on the whole it has been found that this combination of deep-cushioned seats and relatively rigid springs produces a better performance than has been experienced in the other way, and the plan has the decided advantage of eliminating spring failures. Moreover, it is feasible to use standard grades of spring steel in this work, and the cost of the automobile, taking it on the whole, is considerably reduced in the face of the fact that the results are more satisfactory.

Among the remaining innovations that are to be ascribed to this body construction, attention is called to the housed-in gasoline tank at the back of the tonneau, with a storage place for tools in a small compartment at the rear of the tank, and referring to Fig. 2, which is a plan and elevation of the body, it will be seen how the tires are slung at the back without obstructing the filler of the gasoline tank, and leaving the door of the tool compartment in an accessible position, the latter being smaller than the inside diameter of the tires. The body is of the fore-door type with an overhanging cowl, and in the elevation it is fitted with a top, showing the arrangement of the windshield and other nice relations. The front of the car is provided with a shield to protect the radiator, and for general touring work metal boxes with water-tight covers and suitable locks are placed on the running board.

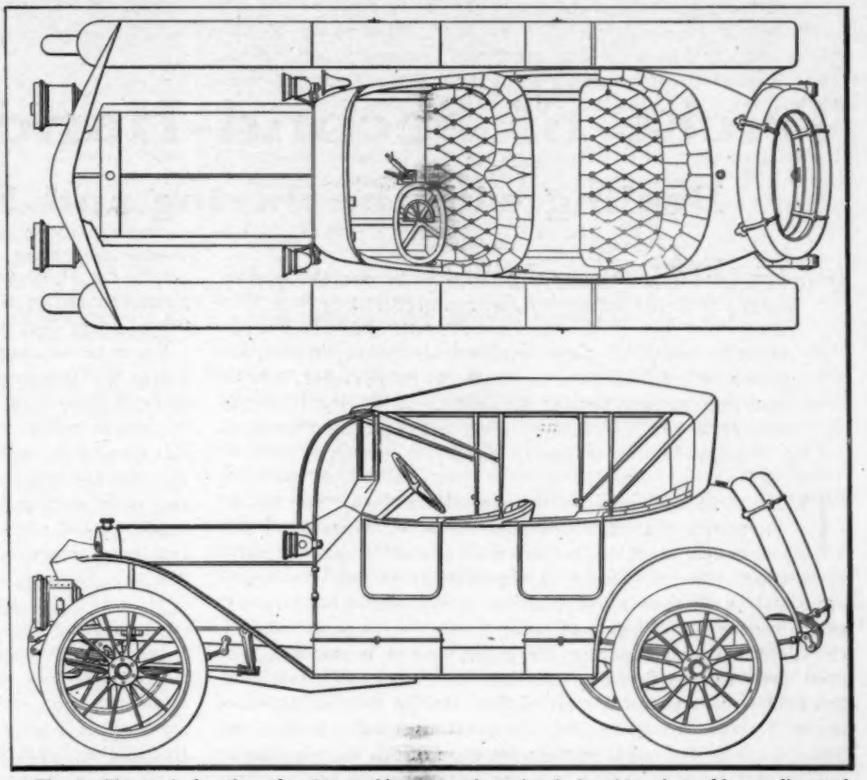


Fig. 2—Plan and elevation of a deep-cushion type of touring body with a housed-in gasoline tank at the back, providing for the storage of tools, and the strapping on of spare tires

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DAMPNESS AFFECTS BODY VARNISH—Damp, ill-ventilated garages cause a great deal of varnish and surface spotting difficult, and often impossible, to rid the surface of. Frequent washing and sun baths assist to both prevent and cure the evil. If this treatment fails, rub the surface down and revarnish.

How It Is Done Nowadays

In the olden times, when the equine held sway, the progress of royalties about their dominions was fraught with much of pomp and splendor—in this era of the automobile there is a whiz, a rush, a cloud of dust, and the spectacle is over. That's the way the King of Italy does it.

THE streets of Rome, Italy, may be swarming with traffic, in the busiest hour of the day. Of a sudden, the shrill reveille rings out—Ta-rant-ta-ra! Ta-rant-ta-ra! Ta-rant-ta-ra! Instantly, all traffic stops. The vehicles plying along in opposite directions part in the center of the thoroughfare. A huge gray automobile with caparisoned chauffeur and Royal Aide-de-Camp whizzes along, to the accompaniment of renewed blasts of the trumpet. The people stand in anxious anticipation. Presto! A tremendous white automobile rushes out of space. In it rides a man small of stature, but mighty of title. The white machine flits by as though shot out of a catapult—away it goes, like a will-o'-the-wisp, as the bright hues of the uniformed occupant with his Aide de-Camp impress the eyes of the beholders. King Victor Emmanuel III of Italy has passed. Traffic resumes its normal gait.

Taxi Drivers' Free School

Fearing lest there be a dearth of chauffeurs for its vehicles, a big motor cab company in London has opened a school where candidates for positions may receive free instruction.

THE British Motor Cab Co., located in the Pimlico district of London, has established a school of instruction to taxicab drivers at an outlay of $3,500 to $4,000 per month to the club, for the purpose of fitting chauffeurs for positions. The school has been open since January, free of cost to candidates. There were 450 of these men who were sent to Scotland Yard to be examined and out of the number, only 32 passed on the topography of London's streets. This condition of affairs has sent a thrill of fear through the taxicab owners, lest it shall happen that there is a scarcity of drivers in the near future.

Tricks of Second-Hand Car Trade

Dealing with the Buying and Selling Phases

Whether buying or selling a second-hand car the owner should seek the advice of some competent person who can advise him if he is not conversant with the proposition before him. Supervision is necessary in the case of the seller and buyers must be prepared to spend time and money before deciding. A friend is a bad adviser in the selection of a second-hand car, because if the car breaks down so does friendship.

THE tricks and wiles of the second-hand car trade are so numerous that it would take many more pages of this magazine than are at present available to go into them thoroughly. Never was the saying *"Caveat emptor"* more appropriately used than when speaking of the second-hand proposition in general. When purchasing a new car there are sundry considerations that confront the buyer, and it is no easy task even then to discriminate between mere salesman's talk and facts. To probe to the bottom of the situation the first question to be decided is: "Why did the previous owner forego the pleasures to be derived from the possession of this most estimable and luxurious car?" The reasons put forward are various. One is—and it is sometimes true—"Because he bought another car of larger power." Other reasons the wording of the various alluring advertisements in the daily press will furnish; as for example: "Going abroad," "need cash," "ill health," and so on *ad infinitum*. Such allurements as "snap" and "worth double the price" are purely the concoctions of the person who draws the advertisement. The words "just overhauled" are forever recurring, and the strictest investigation as to who did the overhauling and its exact extent should be made by the prospective buyer. Some people think that when they have ground the valves in and cleaned the motor down with a little gasoline the overhaul is complete.

The Buyer Needs to Have Lived in Missouri All His Life and Just Come from That State When He Begins His Treasure Hunt

If the buyer starts on his peregrinations with the idea that New York, or any other city for that matter, is hiding gold dust in the shape of automobiles that can be had for the price of silver he had better return to his native State, and have another guess. There are no doubt reputable firms selling second-hand cars who will not place on their books anything they do not consider, after examination, to be in good condition; but, sad to relate, they are few and far between. One has to be prepared in the second-hand car hunt to come in contact with the unscrupulous class of dealers.

A golden rule, and one that will never fail, is to hold on tight to any money until the car is out in the street throbbing ready for delivery. Deposits are not to be considered under any circumstances; if some one else comes along and buys the car over one's head, be thankful that he got it. If a car is being offered at a low price through a dealer there is something the matter with it. He is not a philanthropist and usually exacts his pound of flesh. Business is business with him and if he can buy a car for $500 and it is worth $1,000, $995 would not tempt him very much. The first price quoted is invariably a *ballon d'essai*, to feel the pulse of the buyer. A counter-offer is always expected and on this account the first price may seem somewhat high. It remains for the buyer to do the pulse feeling, and if he cannot get the car at his price he should "pass it up." These may seem platitudes, but in the eager moments of price wrangling and a tickled fancy they are apt to be lost to sight.

Never be in a hurry about the purchase of a second-hand car; it may have been on the floor for months, although the salesman says: "It came in yesterday." Unless the buyer is experienced in cars, in which case few of these remarks will apply to him, it is cheaper to employ a competent, reliable engineer to look the car over and pay him a fee for so doing. That seems reasonable and plain sailing, but therein lies the first pitfall. There are engineers and engineers, and it is not an unknown happening to find the engineer in cahoots with the "second-hand" man. Salesmen usually work on commission and are pleased to split it with anyone who can influence a sale. Who can do it better than the engineer if he desires to prostitute his calling and become a Judas to his employer? This in a measure would eliminate the engineer, but anyone with a reputation would not spoil his whole career by such underhand methods. It is cheaper to pay a good price for advice than to become saddled with a several hundred dollar "junk pile." Preliminary to the engineer's visit it is as well to make a selection of possibilities that would come within the bounds of the purchaser's ideal and extent of his pocketbook. Paint is skin-deep and costs very little to buy. Dig down deep into things mechanical! Never take "Oh! we can fix that" for an answer. Make them do it, and if they are not so inclined drop it like a hot coal.

A run around the block is no test, but in fairness to the seller, as his time is valuable to him and gasoline and man's time cost money, offer a small sum as a proof of *bona fide* to have a run of, say, ten miles or more, and in the case of a purchase the hire money to be deducted from the bill. Never have verbal understandings about second-hand cars. Black and white are the only proofs, and they should have the signature of a responsible officer of the company. These gentlemen are often in the background, but are always within easy calling distance. The salesman has to earn his living and is not responsible in some cases for what he says. The proprietor is differently situated, however. It is no uncommon occurrence for the owner of the second-hand emporium to repudiate his employee's statements after the unwary buyer has paid over his hard cash and wants it back and starts telling of all the car was supposed to do and what it does. This is part of the business and is nothing more than pantomime for at least two of the actors. Tires cost a lot of money and in the majority of cases they are old and hanging together by a few threads. The reason for this will be found out later in the story. There is a dearth of accessories on the car, and the reason for this will be the same as the condition of the tires. There remains the body and chassis, not taking into consideration the windshield and top, if such are left on the car.

Before Purchasing a Second-Hand Car It Should Undergo a Critical Mechanical Examination at the Hands of an Expert

The first place to look at on a car is the gear box. Have the lid removed after other smaller preliminaries have been gone through with, such as starting the motor and feeling the steering for backlash and a glance at the upholstery for wear due to friction. If it is worn, somebody must have sat on it sufficiently long to wear it—a good indication of 5,000 miles running. If

the gears are in good condition it will show either of four things, viz.:

1. The car has not run much.
2. The previous owner or driver was careful.
3. That they are made of good materials.
4. That they have been renewed.

All first-class qualities, except the last, which is in itself, however, a hopeful sign.

If the gears are not in good condition, beware! They are an excellent barometer—a good piece of metal properly treated should not show much evidence of wear after 20,000 miles; consequently they cannot be taken as a means of telling age. But if the material is poor, 2,000 miles will show the ravages of wear or carelessness in the previous owner's hands. Both are equally bad and the car should be immediately "passed up."

If the motor is inclined to "race" when standing still it would be well to pass that particular car by or call again later when it has been "fixed."

This leads to the main point of the theme on the part of the buyer. "Fixing" is an art, and the man who does this work is worth his weight in gold. Is it not he who with his deft fingers puts those *"Meisterstück"* touches here and there that make things "go" for a short while? If he would only speak, what a story he could tell! How that old 16-horsepower ————'s rear axle was noisy and he filled it with sawdust and cork chippings, and the way he had to hold the clutch in with his heel over the slightest grade, not forgetting that for the 10 o'clock appointment he was waiting a block away, letting the motor cool off, even taking the trouble to go to the saloon on the corner and fill up the radiator with cold water, and with pride call the prospective buyer's attention to it to show how cool she kept! But that is forgetting the 40-horsepower ————. How he changed the magneto and carbureter for the run and put the old ones back afterward and packed those timing gears with heavy grease to deaden that awful rattle are inside secrets. Goodness knows what would have happened had there been any real necessity for the brakes. There was no foot brake at all and the side brake shoes were burnt out. If he were to become talkative you would find out that the first and second speeds on another car were useless and that it was necessary to start on third speed with the clutch slipping for half a block to prevent the motor stalling, and that he filled the base chockfull of oil, as the lubricator was out of order.

If There Are Poor Tires on the Car Stipulate for Good Ones Even at a Slight Extra Expense

Such tricks he could tell by the score. He is much in the same position as the magician who does wonderful sleight-of-hand tricks that bewilder the average public. To the initiated such feats are purely a matter of adeptness and much practice, and so it is with the mechanic. The engineer will be able to see through any deception if he knows his business. A favorite method, and one that often works, is to feign indignation when a critical examination is about to be performed. The seller charges the buyer with want of credulity and sometimes even goes so far as to say that he does not care if the car is bought or not. That is entirely a matter for him to decide, and as he is ostensibly there for business such trivialities should not upset the equanimity of the buyer. It never pays for the buyer to show the slighest spark of zeal; to the contrary, a matter-of-fact unconcern will draw out the seller to a marked degree.

Some indication of the methods under which the cars find their way to the second-hand stage will help the buyer to better understand the situation and perhaps serve as a caution to those who have cars for sale.

There are three methods of disposing of second-hand cars; first, by private treaty, where the seller acts as his own agent, inserting advertisements in such periodicals and daily papers as make a specialty of such advertisements. The method of procedure is to fix a price that one is prepared to take for the car and draft a truthful advertisement stating the make, horsepower, year of manufacture, type of body and accessories that form part of the equipment. The price may be stated or not, as the seller chooses, but it is usual when stating a price to allow a margin for counter offers and eventual commissions. A large proportion of the resulting replies are from brokers and dealers who either offer to sell the car on commission or who say they have a purchaser for such a car as the one advertised. Others are bolder and offer to buy the car outright. Others again will offer to take the car in and house it free and sell it.

Wherever Possible It Is as Well to Deal with the Intending Buyer Direct

The buyer prefers it and feels more at home. Offer to have the car inspected by an expert, but should this gentleman make any overtures with reference to a commission for his services, so that he is serving two masters, it is the duty of the seller, in fairness to himself and to the man who is employing him, to inform the prospective buyer of what has taken place. The buyer will be very thankful for such knowledge and will be more inclined to believe the seller than his "expert."

In the case of brokers their method of procedure is much the same as the one above outlined. They have to keep lists of cars that are for sale and they insert advertisements also. The type of advertisements are sometimes alluring and when the buyer calls it is a most strange thing that usually the car has been sold the day before, as the advertisements are often fictitious. The broker, having in hand a prospective buyer for a car, scans his list to find something similar that might interest him. The list is made up of cars of private owners, who may desire to sell, and as there are no charges unless a sale is effected, there is no harm in allowing the broker to list the car, and the possibility of a sale will be increased. Trial runs, however, are the sore spot in the scheme. A broker will in some cases force his client to take a run in a car that he has access to readily to keep him "sweet," so to speak. Appearances are sometimes deceptive, and a homespun-clad countryman will often prove to be more inclined to buy than the glib-tongued gent with immaculate style. The latter probably has nothing better to do, while the other may be on business bent.

It is not every one that has the time and inclination to be burdened with the selling of a car and for such there are salesrooms open where the car will be taken in and housed, cleaned and sold on a commission basis. There is a saying that there is more roguery in car selling than in horse dealing. Be that as it may, it is a well-known fact that the seller is foolish if he starts out with the idea that every one in the business is an angel. The better course to pursue is to think in the opposite way and thereby eliminate any chance of being worsted. Unpretentious places should be avoided for two reasons, the first being that the car will not improve in squalor, and secondly, that garages, like mushrooms, spring up in the night and the proceeds of the sale of a car or two may give their owners a long search for their money. Such cases are not without precedent. References to satisfied customers of some standing or to some reputable dealer in cars should settle the question as to whether or not the particular party is fit to be entrusted with the equivalent of the seller's money.

Verbal understandings are of no use in a court of law, consequently it behooves the seller to have everything put in writing. The contract offered by the agent—for such he becomes if a car is entrusted to him for sale—are usually worded in such a manner that the seller has very little chance of seeing his car for some time once he has handed it over. There is one clause that looks quite harmless, but should be rigorously deleted. It refers to the question of time that the car is to be held on sale. Thirty days is often the period, and there is a proviso that in case a deposit is received within that time a further thirty days must elapse before the owner can become repossessed of his car. This proviso should be replaced by one that gives the owner the right

to take his car away at any time. The reason for this is simple. In case the owner has a purchaser in the first 30 days—and it is not unreasonable for him to try and sell the car himself in the meantime—and he wants to give a demonstration he will find the agent stand by his contract and prevent the owner of the car having any use of the car until the contract time has expired, and what is there to prevent the agent from placing a $50 deposit himself on the car in a friend's name and detaining the car for a further thirty days? Nothing in the world, and it is done quite often.

An Owner Who Desires to Sell His Used Car Should Take Nothing for Granted; He Should Make a List of All Spare Parts and Mark the Tires for Identification

All spare parts should be listed and signed for by the agent and the numbers of the tires noted. Just as there are tricks in selling a car, so there are when the car is taken in on commission.

The usual procedure is to denude the car of everything, for two reasons, the first being to prevent their being stolen and, secondly, that in case a purchaser agrees to buy the car as it is the extras will remain the property of the agent, or they may be used as a bait in the concluding scenes of the sale of another car. Of course the owner might as well keep the spares himself until the car is sold, giving a list to the agent, and as they are not shown on the car at all there is no harm done; and in the case that the car is sold without them the owner is the better off instead of the agent. The commission alone is not what the agent is looking for; the sundry concomitant perquisites that go with the car increase his harvest.

It is the owner's duty to himself to visit the agent's repository every week without letting the agent know at what time he is coming, and have a good look at the car to see that it is being properly cared for. Cases have been known where the car has been placed in an inconspicuous position so that it will not attract the notice of possible buyers who may visit the agent's place of business. This may seem a foolish way to do business, but the reason for this is that the longer the car is left on storage and the patience of the owner has become exhausted the lower price will he accept for his car. Tentative offers are made from time to time, and in a lot of cases these emanate from the agent himself. When at last the owner throws up his hands in abject disgust and is willing to sacrifice the car at any price the agent steps into the breach and either finds a buyer or buys the car himself. The celerity he then exhibits is amazing, and no stone is left unturned to effect a quick sale. This method is morally dishonest, but the legality cannot be disputed. One method of cloying the hungry edge of the agent's appetite is to offer him a bonus as an inducement if he sells the car within a certain time.

The owner has a perfect right to be informed when a trial is about to be given, and is wise to exact this information. Precedent is not wanting to show that the car is used for an outing on Sundays to test its capabilities and even sometimes for profit in the shape of a hire. Any conversation should be reduced to a written confirmation the same day and a copy of the document carefully filed away in case of need. The contract note should contain a clause with reference to insurance, either that the car is covered by the agent or that the owner takes care of this item himself. In the event that the agent holds the car covered, ask to see the insurance policy and have a letter dictated to the insurance company specifically mentioning the particular car and cause a copy of the acknowledgment to be forwarded. Accidents that may take place while the car is in the agent's possession must be similarly treated, and a cover for this also obtained.

As a final injunction it is well for the owner to be reasonable and accept the first rational offer for the car and conclude the transaction rather than have the encumbrance on his hands for any length of time.

Items from Distant Lands

Interesting extracts, mainly from the United States Consular Reports, in which the status of the automobile in foreign parts is tersely set forth, and the prospects of extending the American market are called to the attention of those interested.

ABOUT a dozen automobiles are possessed by residents of San Miguel, the largest of the group of Azores Islands. The dwellers on the other islands have no automobiles at all for the accommodation of the 270,000 souls. The highways, many of which run over mountains, some with an altitude of 3,000 feet, are handicapped with pumice-stone and lava, substances which are murderous to rubber tires.

A French construction company will undertake to build 1,300 miles of fine highways in Asia Minor, which will gridiron the country in certain sections. People who live there are sanguine enough to predict a great future for the automobile, after the roads shall have been built, which, according to the terms of the contract, must be within the space of three years.

His Highness, the Gaekwar of Borada, India, has in his collection of motor cars two of twelve to fourteen horsepower, both being of British make. His Highness is an enthusiastic motorist and a great many of the upper-caste Indians have their eyes fixed upon motordom with the desire to emulate the Prince.

The automobile manufacturers of America exported into Canada 2,121 motor cars from May 1, 1910, to December 31, 1910, their value being $2,474,462, as compared with 1,457 machines worth $1,816,164 imported from the United States into Canada from April 1, 1909, to March 31, 1910. It is worthy of note that from May 1, 1910, to December 31, 1910, Canada bought only $205,519 worth of automobiles from Great Britain.

Two American-made automobiles recently won prizes during an endurance run between Gothenburg and Stockholm, Sweden. Thirty-three motor cars divided into two classes participated. Those of the first class were unlimited as to price or power, while the second class contestants were circumscribed to cars which sell for 6,000 kronor ($1,608) or under. A Belgium-made car carried off the prize in the first class, while a German-made car took the smaller class prize.

France sold during 1910 automobiles as follows: To the United Kingdom, $13,847,171; to Belgium, $6,125,820; to Germany, $2,679,947; to Argentina, $2,014,534; to Italy, $1,073,080; to the United States, $926,207 (in contrast with $1,554,229 in 1909); to Spain, $495,238 (as compared with $643,848 in 1909); these figures making a total of $27,162,001 worth of automobiles exported to other countries, while the machines sent to nations not enumerated here sent the grand total up to $35,030,272, which was $6,755,000 in excess of the showing for the year of 1909.

The Cunard Steamship Company issues through bills of lading to the interior points of the Kingdom of Austria-Hungary and delivers automobiles of 1 1-2 tons weight and less for $4.87 to $6.08 per ton of 2,240 pounds or 40 cubic feet at ship's option, 5 per cent. primage. Motor cars weighing more than 1 1-2 tons are subject to a variety of rates.

Austria-Hungary's electric light and power plants from which automobilists may obtain current for the recharging of batteries are the property of the respective municipalities, and are controlled by a bureau of public utilities. The cities are well supplied with these plants and the automobilist on tour need have no fear of his electricity running out.

There is a tariff duty of $14.28 per 100 kilos (220 pounds) on rubber tires imported into Germany and to this tax the freight must be added from the factory to the sales center in Germany. These figures have to be taken into consideration when mention of competition is made. It is incumbent upon the American manufacturer, if he would sell goods in Germany, that he should show beyond dispute that he can supply German buyers with not only a superior quality of tires, but also that the difference in the price is well worth the purchaser's while.

Injunctions as to Second-Hand Cars

Before Purchasing, It Is Well to "Stop, Look and Listen"

DON'T, just because the price sounds low, purchase an automobile that will not run; are you not aware that old iron is worth about one cent per pound?

DON'T be skeptical; there are good second-hand automobiles to be had—be diligent; scrutinize the entrails; if trouble is indicated, remember that you can scarcely be expected to see all of it; play safe in that event.

DON'T allow the second-hand man to set his words to music and sing the lullaby that will make you sleep while he annexes your hard-earned coin.

DON'T exhibit grief if you purchase a second-hand automobile and, failing to examine it, discover that it is a white elephant instead.

DON'T take excuses—demand that the automobile be in serviceable condition, or learn the reason why.

DON'T buy a second-hand car by the outside looks; get someone who knows to look inside.

DON'T forget that in polite society a second-hand automobile is called a "used automobile."

DON'T overlook the fact that it may be a very much used car at that.

DON'T think that a rebuilt demonstrating car, so-called, is a new automobile.

DON'T become confused if it is said that the car is almost new and has not gone 1,000 miles—a precipice is not 1,000 miles down—but the going is such that the automobile that negotiates it will have a couple of broken ribs.

DON'T look in the eye of the man that is telling you how good a second-hand car is; look in the eye of the car and see if it has a cast in it.

DON'T listen to the wiles of the man who says the car is almost new when the finish on the body shows that it has gone through the revolutionary war.

DON'T go by the name plate; some wag may have replaced it by a more modern one.

DON'T think that a second-hand car is good just because it cost a lot of money in the first place.

DON'T let the demonstrator try out the second-hand car that you are to put your faith and your money in under an elevated railway; the elevated may make more noise than the car.

DON'T persuade yourself that a car is making all the noise that it can when the demonstrator is nursing it along the boulevard at a low speed; try it out on high speed; give it a little cobblestone going; if it rattles like a saw mill purchase it as one if you have very little wood to saw.

DON'T pay too much for a car that stands the light of a searching examination after it is found that it is free from impossible troubles—remember that it is still a second-hand car even if it does appear to be in an excellent state of preservation.

DON'T be blinded by a lot of junk accessories—what you need is an automobile that will run, and in which some of the original sweet-running qualities may still be discovered.

DON'T figure on the tires being of any value; they may be chalked up; it is possible that they were given hot water treatment before being put on; the inner tubes cannot be seen through the outer casings.

DON'T let your misfortune serve as the stepping stone for the fellow who unloads a decrepit automobile.

DON'T fail to test the car out on the several gears; it may not be silent on any of the gears excepting "direct."

DON'T make haste in reaching the conclusion that silent performance is a sure sign of quality; the car may have been enjoined to be silent.

DON'T forget that the rattling joints of a car, if they are filled up with paint, will cease to rattle.

DON'T overlook the practice of putting bee's wax on the gears to silence them.

DON'T forget, the more the car cost in the first place, the greater will be the depreciation cost in the long run; if the depreciation is 10 per cent., for illustration, this percentage of $6,000 is $600, and a like percentage of $1,000 is but $100.

DON'T overlook the fact that the depreciation of an automobile will be greater if the power plant is designed for high speed than will be true if the power available is barely sufficient to propel the car at an ordinary speed—the difference is very noticeable.

DON'T invest in a sagging live rear axle; if it can be fixed up let the seller do it. If it cannot be fixed, let the seller stew in his own juice.

DON'T accept a car that has a worn-out steering gear; lost motion will tell the tale; if the demonstrator says it is but a trifle, and that it can be fixed, why beat him out of the pleasure of showing you just how clever he is?

DON'T be induced to disregard the poor performance of the emergency brakes; the demonstrator may want to keep from you the information that they are faulty in design and cannot be made to work; if he says that 50 cents will reline them and make them better than new give him a dollar and turn him lose on the job.

DON'T invest in a car that has a cooling system that fails to maintain the normal working temperature of the cooling water. If the water boils when the car is standing at the curb, it is a sign that the cooling system is not what it should be.

DON'T let the demonstrator convince you that cooling trouble is a slight derangement that can be remedied at the cost of a special delivery postage stamp—if he goes on that way, pay him the amount and let him do the work.

DON'T be deceived; if there is a compression release on the car the demonstrator may be able to conceal the fact that the compression is far from good; he will point out that the compression should be slight when the release is used, as in cranking, but this will prevent you from finding out just how bad the compression is unless you try it when the release is not working.

DON'T fail to remove all the lubricating oil, and after replacing it with a normal grade, determine what the true conditions of compression are; the power of a motor, as well as the fuel economy, increases with compression.

DON'T be satisfied with leaking valves; the leak may not be the sign of serious trouble; if the demonstrator says the valves can be ground in to make them tight, let him show you—the real point is, can they?

DON'T fail to observe the condition of the springs; if they are in a state of "sag" it is easy to determine the fact; all that is necessary is to measure from the floor up to the underside of the chassis frame on both sides of the car; if there is a sag, one side will be down.

Aluminum: Its Properties and Uses

With an Insight Into the Methods of Its Production

In view of the growing importance of this erstwhile little-known and less-used metal in the arts, this article, from the pen of William D. Ennis, Professor of Mechanical Engineering in the Polytechnic Institute, Brooklyn, N. Y., is most timely. The author succinctly details the history of this most abundant and useful metal from its discovery, a century ago, up to the present time, giving an outline of the various processes used in its production and the uses to which it is being put.

THIRTY years ago aluminum was almost as much of a mystery as radium is to-day. An early report of the United States Geological Survey fixed its price at $15 a pound. The production in 1883 was estimated to be less than a hundred pounds, and the metal was then regarded as a mere chemical curiosity. In 1909 the output was about 17,000 tons, valued at about 23 cents a pound in raw ingots. Yet it has long been known that aluminum is of all metals the most abundant. Every clay bank is full of it. Its oxide makes about one-sixth of the crust of the earth. It is found in all the older rocks; in fact, in all important rocks excepting sandstones and limestones; and in marl and slate. Its pure crystallized oxide forms the ruby, the sapphire and corundum; in a less pure state it is known as emery. Ordinary clay, which is the disintegration product of feldspar rock, contains from 12 to 20 per cent. (rising in bauxite to over 30 per cent.) of aluminum in the form of a silicate.

The metal is never found isolated, like gold, silver and even iron. It is for this reason that nearly a century elapsed after its discovery before it became serviceable to man; for its strong affinity for oxygen makes its separation from native compounds a matter of much difficulty and expense. Sir Humphry Davy attempted, as early as 1807, to decompose the oxide, alumina, and suggested the name *aluminum* for the hypothetical metal. He actually produced what was probably an alloy of aluminum with iron, but it was not until 1827 that Professor Wöhler at Göttingen first obtained the free and nearly pure metal in the form of a grey powder, the chemical properties of which he investigated. The actual manufacture of the metal began some years later. In 1878 aluminum was obtainable at a price slightly exceeding $10 a pound. By 1889 the selling price had decreased to about $4. Early in 1891, the electrolytic processes brought the price down still further, to about $1. By this time various alloys were available for casting, forging and rolling, as well as ingots of commercially pure metal. Plates, bells, springs, tubes, sheet and wire were regularly made. By 1893 various working processes, including plating and soldering, had been developed. The price fell to 35 cents a pound in 1895. The chart shows the steady reduction in price since 1856.

Processes for Making Aluminum

Wöhler had prepared his sample of the metal by treating aluminum chloride with potassium. Sainte-Claire Deville, in 1854, proposed the substitution of sodium for potassium; and the cost of producing aluminum was for many years largely determined by the cost of sodium. In addition, the chloride must first be prepared from the naturally occurring silicate. The reduction of the chloride was found to be facilitated by the employment of *cryolite*—aluminum-sodium fluoride discovered in Greenland—as a flux. In the Castner improvement (1899) on Deville's method, the sodium was prepared from its caustic hydrate by the action of an iron carbide at fairly low temperature. The double chloride of aluminum and sodium employed as a source of the former was formed by passing chlorine gas over a mixture of clay, carbon and common salt, and afterward freed from impurity by a special treatment. It was then mixed with cryolite and sodium in a highly heated furnace. In other improvements special means for producing sodium, for reclaiming cryolite slag, or for producing the chloride of aluminum have been adopted.

Besides sodium, sulphur and carbon, iron, fluor spar and a number of other reducing agents have been introduced or proposed; but an overwhelming proportion of the aluminum produced prior to about 1890 was the result of the action of sodium. In 1883 Cowles, in this country, proposed the use of an electric furnace (current to be generated by water power) for smelting zinc ores. This suggested Hall's proposal (1889) for the electrolysis of alumina while in solution in a molten bath of cryolite, which has become the basis of modern methods of production, depending for their economy only on cheap power. There are two ways in which the electric current may be utilized: as a heating medium, replacing fuel and supporting a chemical reaction between certain constituents, and by electrolysis, in which the reaction is produced by electrical means only, as in an ordinary galvanic battery, the associated heat phenomena being regarded as incidental. In the first, or electrothermic process, alumina may be reduced in the presence of carbon or a metal with or without a flux; or, as in the Cowles furnace, the finely-divided ore may be subjected to a high temperature in the presence of carbon, iron or copper; the corresponding alloys being produced.

Properties of the Metal

In the electrolytic process the compound must be first melted (this can be, of course, accomplished by preliminary electrothermic methods), in a furnace suitably lined and equipped with proper electric terminals. One of the early experiments of Davy consisted in covering a platinum plate (the positive pole of an immense galvanic battery) with damp alumina, in which an iron wire was introduced from the negative pole This caused a fusion which resulted in the production of his iron-aluminum alloy. Deville passed the electric current through molten aluminum-sodium chloride, depositing metallic aluminum on one of the terminal plates of the crucible. Later, the solution for decomposition was a fused mass of cryolite and salt, or chloride and fluoride of the metal, alumina and cryolite, etc. The electrolytic operation is merely the climax, therefore, of a series of reactions intended to fit the raw clay or rock for ultimate decomposition. The power of Niagara Falls is silently at work in the machines.

When aluminum was less known than at present many fanciful statements were made as to its properties and probable uses. Ships, locomotives and rails were to be made of it. Aerial and automobile locomotion would be expedited. It was "as strong as steel and as light as wood." It existed in unlimited abundance and would eventually be "as cheap as dirt."

As a matter of fact, it is more than four times as heavy as wood, more than one-third as heavy as iron. Yet at this it is the lightest of the common metals; only magnesium is lighter. It is less than half as strong (for a direct pull) as good iron.

Chemically, it is classed with the rare metals gallium and indium, two substances which are commercially unknown. It is extremely non-corrosive, but may be dissolved by hydro-

chloric acid or strong caustic alkali. It resists the action of water, hot or cold, fresh or salt. It melts at 1,160° F., a temperature intermediate between those for melting zinc and silver. It is wholly non-magnetic, but is highly electro-positive, and contact with other metals is to be avoided where electrolysis might occur. It expands, under heat, about twice as much as iron and half as much again as copper. Its specific heat is higher than that of any other common metal—about 0.22; one-quarter that of water, twice that of iron. It, therefore, "warms up" slowly. It is an exceptionally good conductor of heat, ranking below copper. The latent heat of fusion (*i.e.*, the amount of heat necessary to melt one pound) is about 51 thermal units.

The common impurities are iron and silicon: the total of the two varying from 1 up to 6 or even 8 per cent. in very poor samples. Slight traces of sodium are extremely detrimental, but are not likely to be present in the electrolytic metal. According to the metallurgists, silicon appears to play a part in aluminum similar to that by carbon in iron; it makes the metal crystalline and brittle. Even a small amount of silicon imparts a bluish color and disagreeable smell and lessens the resistance to corrosion. A small proportion of iron is said to make the metal denser and stronger; any proportion above 1 per cent. soon makes it brittle. Copper not exceeding 5 per cent. whitens aluminum, increases its strength and lessens the shrinkage in casting. Commercial aluminum at present is more apt to contain an injurious quantity of silicon than of any other impurity. Numerous analyses of the trade grade of metal show iron below 1-2 of 1 per cent. (probably not harmful) and total silicon (graphitoidal and combined) below 3-4 of 1 per cent. One of the leading manufacturers grades the product on the following approximate analysis:

	No. 1.	No. 2.
Silicon	0.30	2.00
Iron	0.15	2.00
Aluminum	99.55	96.00
	100.00	100.00

On the average, the silicon is present in the proportions of one-third graphitoidal to two-thirds combined. Quick cooling of the molten metal appears to increase the ratio of the former to the latter; the opposite is the case with relation to carbon in iron. Besides silicon and iron, aluminum may contain small amounts of copper, nickel, tungsten, manganese, chromium, titanium, zinc or tin; by accident or by intention. These constituents may increase hardness, rigidity or strength without materially detracting from lightness or non-corrosiveness. Traces of amorphous carbon are occasionally found. These decrease the strength and (in the cast metal, at least) the elasticity. The same effects are produced by occluded gases, like nitrogen and carburetted hydrogen, which also cause blow holes in the ingots and laminations in plates rolled therefrom, and may make the metal more subject to corrosion than when in the gas-free state.

Physical Properties of Aluminum

The specific gravity of the pure metal may range from 2.56 in castings up to 2.68 in worked material, and still higher values are found for the slightly alloyed specimens of commerce. The presence of silicon tends to reduce the specific gravity. When alloyed the metal weighs more than would be anticipated from any calculation based on the weights of the constituents, indicating a contraction during mixture.

For many purposes, in which strength is not a leading factor, aluminum may, on account of its low specific gravity, profitably replace other metals which cost less per pound. The relative costs of equal volumes of some of the common metals are about as follows:

Nickel	468	Lead	50
Aluminum	67	Cast Iron	8
Tin	120	Zinc	31
Copper	97	Steel	17

Even when strength is considered the lightness of aluminum often tends to its advantage, because in many applications the weight of the piece itself constitutes a part of the strain on it. Thus, the longest bar of wrought iron which, hanging vertically, could support its own weight, would measure about 15,000 feet; the corresponding bar of aluminum would be 23,000 feet long. In sheet metal work it is size rather than weight that is considered, and since copper sheets are three and one-third times as heavy as aluminum, the latter metal would be the cheaper, in sheets of given thickness, wherever its price did not exceed three and one-third times that of the former. Only high-grade aluminum bronze or cast steel are stronger, weight for weight, than aluminum.

The color of the metal is described as white with a slightly bluish tint, less yellow than ordinary silver or tin. Whiteness appears to be related to the degree of purity; with 15 per cent. of combined silicon and iron the metal is as blue as lead. Long exposure to the air increases the bluish tint. The same effect follows working or polishing. When fractured the surface is slightly fibrous, and this characteristic is intensified by long working. The metal is of rather open, porous structure, and when used on parts subjected to internal fluid pressure must be especially thick if leakage is to be avoided.

Strength as Evidenced by Tests

The following are average values for 99 per cent. pure metal:

	Pounds.
Elastic limit per square inch in tension (castings)	8,500
Elastic limit per square inch in tension (sheet)	12,500 to 25,000
Elastic limit per square inch in tension (wire)	16,000 to 33,000
Elastic limit per square inch in tension (bars)	14,000 to 23,000
Ultimate strength per square inch in tension (castings)	12,000 to 14,000
Ultimate strength per square inch in tension (sheet)	24,000 to 40,000
Ultimate strength per square inch in tension (wire)	25,000 to 55,000
Ultimate strength per square inch in tension (bars)	28,000 to 40,000
Per cent. of reduction of area in tension (castings)	15
Per cent. of reduction of area in tension (sheet)	20 to 30
Per cent. of reduction of area in tension (wire)	40 to 60
Per cent. of reduction of area in tension (bars)	30 to 40

Elastic limit per square inch under compression in cast cylindrical short columns, with length twice the diameter, 3,500 lbs.

Ultimate strength per square inch under compression in cast cylindrical short columns, with length twice the diameter, 12,000 lbs

The modulus of elasticity of cast aluminum is about 9,000,000.

More definite figures, given by Professor Richards in 1896, are:

TENSILE TESTS.

No. 1 Quality Commercial Metal, Averaging Over 98 Per Cent. Pure.	Elastic Limit, Lbs. per Sq. In.	Ultimate Strength, Lbs. per Sq. In.	Percentage Reduction of Area.	Estimated Safe Working Strain, Lbs. per Sq. In.
Ordinary castings of over ½ inch area, as cast	6,132	15,640	8.7	3,000
Same, annealed	6,600	17,100	15.0	3,500
Same castings, hardened by cold drop forging	10,000	24,000	18.0	3,000
Rolled bars, left hard	16,000	32,500	42.0	6,000
Same, annealed	13,870	25,000	49.1	6,000
Hammered bars, left hard	14,630	24,120	35.1	5,500
Same, annealed	14,000	22,000	43.0	5,500
Wire, ½ to 1-6 inch diameter, as drawn	12,000	24,500	58.5	4,500
Same, annealed	10,870	22,830	65.6	4,500
Wire, 1-16 to 1-30 inch diameter, as drawn	32,000	54,000	68.0	12,000
Wire, 1-30 to 1-300 inch diameter, as drawn	26,000	49,000	54.0	10,000
Same, annealed	21,000	33,000	62.0	7,000
Plates to ⅛-inch thick, as rolled	9,300	22,740	12.4	4,000
Same, annealed	8,500	17,740	13.7	4,000
Sheets, ⅛ to 1-30 inch thick, as rolled	12,500	25,000	35.5	4,500
Same, annealed	10,700	21,070	39.0	4,500
Sheets, 1-30 to 1-100-inch thick, as rolled	13,500	27,500	40.0	4,500
Same, annealed	11,000	23,000	43.5	4,500

COMPRESSION TESTS.

Same Metal as in Above Tensile Tests, About 98 Per Cent. Pure.	Elastic Limit, Lbs. Per Sq. In.	Ultimate Strength, Lbs. Per Sq. In.	Size of Original Specimen, Inches.*	Size After Failure, Inches.*
Ordinary casting, as cast	3,565	12,730	1 x ½	0.985x0.503
Same, annealed	2,037	10,185	1 x ½	0.975x0 506
Same, hardened by drop forging	4,583	15,275	1 x ½	0.965x0.508
Rolled bars, left hard	2,263	9,054	1½x ¾	1.459x0.760
Same, annealed	2,043	6,809	1½x ¾	1.468x0.756
Hammered bars, left hard	5,659	11,320	3 x1½	2.91 x1.520
Same, annealed	5,094	11,320	3 x1½	2.91 x1.519
Metal containing 4½ per cent. silicon and 1½ per cent. iron, casting, unannealed	4,800	15,275	1 x ½	0.965x0.508
Metal containing 1.14 per cent. silicon and 0.06 per cent. iron, casting, unannealed	4,583	12,730	1 x ½	0.975x0.507
Same, larger specimen	5,094	11,320	3 x1½	2.92 x1.519

*Length by diameter (round specimens).

The conservative figures recommended by Hunt, Langley and Hall for metal 97 to 99 per cent. pure are:

	Elastic Limit in Tension, Lbs. Per Sq. In.	Ultimate Strength in Tension, Lbs. Per Sq. In.	Percentage Reduction of Area, in Tension.
Castings	6,500	15,000	15
Sheet	12,000	24,000	35
Wire	16,000-30,000	30,000-65,000	60
Bars	14,000	28,000	40

By the same authorities the modulus of elasticity is given at 11,000,000 for castings, 19,000,000 for cold-drawn wire and 13,000,000 for sheets and bars. Aluminum, therefore, stretches about as much as silver, one-fourth as much as lead, three times as much as steel. The tensile strength of the wire varies usually with the temperature. Working the metal invariably increases its tensile strength, while annealing decreases the strength but at the same time greatly increases the elongation. The texture and strength are both improved by subjecting the ingots to pressure while at a high temperature. The strength and related properties of pure cast aluminum are not greatly different from those of cast iron, excepting the ultimate compressive strength, which is only about one-tenth of that of the more common metal. Very few castings are made of the unalloyed aluminum.

Common Alloys of Aluminum

In order to increase the tensile strength of cast aluminum other metals are mixed with it in various proportions. Alloys of this sort are also found to impart desirable properties to the worked material in the form of plates, bars or wire. Aluminum will unite with practically all other common metals excepting lead and mercury. In order to obtain stiffness and rigidity in castings, without impairing strength and ductility, zinc, iron, manganese or copper may be added; the tensile strength of these mixtures being usually from 20,000 to 25,000 pounds.

Generally speaking, there are two classes of alloys: those which are mostly aluminum and those which contain only a small proportion of this metal. In the latter class of alloys belong aluminum brass and aluminum bronze. These are heavy but quite non-corrosive. They are hard and take a high polish. The bronze contains from 7 to 11 per cent. of aluminum with copper. If this proportion of the former metal is exceeded the alloy becomes brittle. Within the limits stated, aluminum bronze is a durable metal, improves with remelting and can be soldered by using a special flux. Aluminum brass contains from 1 to 10 parts of aluminum in a mixture of about two-thirds copper and one-third zinc. This makes good castings, but has little of the lightness of aluminum. With a minimum percentage of this constituent the tensile strength of the brass is from 40,000 to 50,000 pounds, the elastic limit 30,000 pounds and elongation may be as much as 10 per cent. in 8 inches.

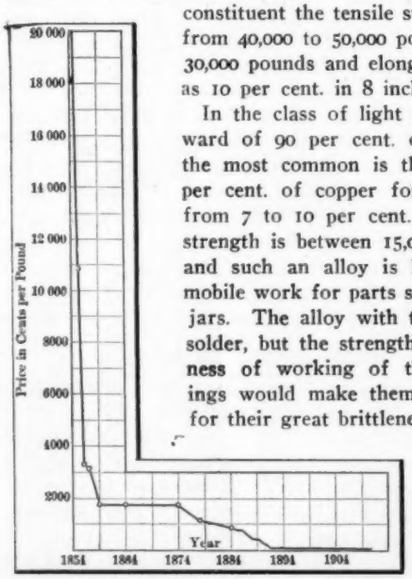


Chart showing the steady reduction in the price of aluminum since 1856

In the class of light alloys (containing upward of 90 per cent. of aluminum) one of the most common is that with from 3 to 6 per cent. of copper for making wire. With from 7 to 10 per cent. of copper the tensile strength is between 15,000 and 20,000 pounds, and such an alloy is largely used on automobile work for parts subjected to shocks and jars. The alloy with tin is mostly used as a solder, but the strength, rigidity and smoothness of working of the aluminum-tin castings would make them desirable were it not for their great brittleness.

Nickel and iron also lead to brittleness. Nickel and tin increase hardness and permit of filing (the pure metal crumbles under this operation). One of the best of the nickel alloys attains a tensile strength of 50,000 pounds, with an elastic limit of 30,000 pounds and a reduction of area of 25 per cent. This is particularly suitable for loaded structural parts, is resilient and rugged and weighs only about 4 per cent. more than aluminum.

The light alloys with zinc are particularly valuable. With from 10 to 15 per cent. of this metal aluminum of fine tough grain, strong and easily machined, is available for such parts as are forged to shape. For castings zinc has been used in quantities up to 35 per cent., making alloys of tensile strength up to 35,000 pounds, which may even be increased by adding small proportions of other metals. The castings are hard, easy to machine and fairly light, but on account of their brittlenes as compared with the copper alloys should not be subjected to severe shocks. Care must be taken not to burn the zinc out of the alloy in the melting.

Aluminum and magnesium make an alloy lighter than the former metal itself, which is yet stronger than the aluminum copper mixture, but this is too costly for general commercial use.

There are a few mixtures intermediate between the "light" and "heavy" classes described, but aside from some use as solder they have no practical importance. One of the most important uses of aluminum is in the manufacture of steel, from 1-8 to 3-4 pound of the former metal being added to each ton of the latter, in the ladle or in the ingot molds. The addition of aluminum purifies and standardizes the steel, makes the mixture easier to pour, produces smoother ingots and increases the tensile strength of the product without decreasing its ductility. Aluminum is also occasionally added to the cupola in preparing cast iron, or to the puddling furnace in making wrought iron. There is no chemical union: the aluminum does not impart hardening properties as chromium and nickel do to steel.

Other Properties of the Metal

Aluminum in the pure state lacks stiffness, rigidity, but the castings crack readily under bending stress. It is highly malleable; sheets have been made nearly as thin as gold leaf.* Its malleability is greatest at high temperatures and is reduced by the presence of silicon or iron. The ground aluminum leaf forms the basis of the "aluminum bronzing" on some steam radiators, which has superseded silver leaf work for use in ornamentation. In ductility, the metal is inferior to iron, steel and copper, but it has been made into seamless drawn tubes and into wire of 1-250-inch diameter.† The hardness varies inversely with the purity; the ordinary commercial metal is nearly as hard as copper and becomes harder as it is worked. Of the common metals only lead and tin are softer than pure aluminum. The relative hardness when shaved with a knife is regarded as a good test of purity.

Castings Made of Aluminum

Aluminum can be cast in dry or (with some risk) in green sand molds or in chills. The molding sand should be loose and porous. Crucibles are usually of plumbago, as for brass; cores must be soft. No flux is used. It is important that the metal be not heated much above its melting point; silicon has been absorbed from crucibles when this precaution was neglected. The molten metal runs thick; this, with its lightness, makes it a matter of some difficulty to properly fill the mold; a built-up gate is sometimes used to provide a "head" for the flowing metal. By pouring under pressure this difficulty is eliminated and in this way highly ornamental castings have been prepared.

At a temperature slightly below its melting point the metal becomes "hot short," *i.e.* brittle; castings may therefore be easily destroyed in cooling. The pouring must be done slowly and with care; aluminum readily absorbs gases and air, forming blow-holes. Dross must be skimmed from the surface before pouring. The use of scums of coke or charcoal dust is not ad-

*A thickness of 1-4000 of an inch is easily attained. With very pure metal the leaves may be made so thin as to be translucent.

†It is stated that a wire measuring 11,400 yards to the ounce has been spun.

vised. In order to hold the temperature down after melting has occurred, small amounts of metal may be cautiously added to the crucible. The shrinkage of pure aluminum in casting is only a little less than that of brass; but the ordinary commercial alloys develop a shrinkage much less than this, or about midway between that of brass and cast iron.

The temperature for annealing castings depends upon the alloy used, but is usually between 650° and 900° F. To add strength, compactness and hardness to aluminum castings, they are often drop-forged in dies to their finished (unmachined) dimensions.

Other Aluminum Fabrications

Aluminum can be rolled like steel. It forges well at a low red heat. The cold-rolling process requires much power, about as much as is necessary to roll hot steel. It is stated that aluminum hardens less under repeated working than other metals.

The pure metal (and many of the alloys) do not machine well. It should be cut at high speed with slow feed and lubrication. The style of tool used and the method of setting the tool are about as for cutting wood. A circular saw can be used for cutting, and drilling is possible with a *sharp* twist drill. In tapping the results are often unsatisfactory, but may be improved by the use of a large hole (larger than for brass), a sharp tap and a lard oil-benzine lubricant.

Sheets are regularly rolled as thin is No. 40 gauge, with hardness varying about like that of copper. Aluminum sheets, on account of the slightly porous nature of the metal, hold paint and enamel particularly well. For spinning, stamping and drawing (as into wire and tubes) aluminum is particularly well adapted. By the use of a proper lubricant it may be stamped or drawn more deeply than copper, brass or steel, and it does not require reannealing.

Some difficulties have been experienced in soldering. This is for four reasons: The alloying temperature is unusually high. The metal being highly electro-positive, a destructive galvanic action is set up at any ordinary soldered joint. The thin layer of oxide which invariably forms on its surface prevents close union with the solder and the high heat conductivity quickly carries away the heat and "freezes" the joint. Welding is possible by electrical methods but with some difficulty.

The best results are obtained with a solder of tin or tin and zinc. A flux containing silver chloride has been proposed, but the rubbing of the surface with solder just before melting is claimed to be more effective in removing the almost imperceptible and rapid-forming oxide scale. A copper soldering iron causes discoloration; one of nickel is superior, but the use of a blow-pipe is preferred as more effective.

A polish may be imparted equal to that of silver; a favorite finish (the "satin") is given by the use of a caustic dip or the scratch brush. This may be further ornamented by burnishing or graining with a flat steel tool. Processes have been proposed for coating sheet iron and stoneware with an aluminum plating.

Uses of Aluminum

No extended account of this aspect of the subject is possible here. The first article ever made of aluminum was a child's rattle, in 1856, for the Prince Imperial of France. The metal was not much less costly than gold at that time. Now it is obtainable in ingots of various forms—ordinary, waffle, pieced and strap; in plain and notched bars; in sheets, tubes (1-4 to 6-inch), pipes (to match with iron pipe, 1-8 to 4-inch) and fittings therefor, rivets, wire and rolled shapes. These are made into a great variety of minor objects of use and luxury, souvenirs and decorations. Scientific instruments, wheelbarrows, bicycles, railway cars, racing sulkies—in all of these it has been employed. As an "aseptic" substance it has applications in medicine; it is used for dental plates. Non-corrosive, it is a useful substitute for iron in certain mining and submarine applications. It has extended uses in chemistry and metallurgy; it is employed for lithographic plates, flash light powders, bells, cooking utensils and mountings for gun carriages. It has even been used to construct a portable bridge for military purposes. Applications have been proposed in the art of coinage. Not only the sheathing but the bodies of boats and ships have been made of aluminum. For electric conductors it is lighter and cheaper than copper of equal conductivity. It is made into fuse wire, into an ornamenting pigment for metal work, and into a long list of other common or curious productions. In no application has it been more serviceable and necessary than in the automobile, and now it is becoming equally essential in the development of flying machines.

Touring Colorado Mountain Trails

Scenic Grandeur Far Exceeds Many in Europe

While numerous American tourists have enjoyed the automobile roads of various European countries, to a large extent they have neglected the wonderful motor trips that may be made under their own flag and in their own country. One of the most accessible of the frontier regions available for automobile touring is Colorado, and this year it will be explored all over again, via the automobile.

FROM the rolling sand dunes that mark the eastern border to the rolling sand dunes where the Utah line presses against its western limits the Centennial State, Colorado, presents a touring field for the automobilist that stands out in interest far and away beyond the majority of European districts that enjoy a fame that is world wide.

The motoring roads through the Royal Gorge, Granite Canyon and in the shadows of the mighty peaks that form the backbone of the continent may not be as perfect as some of the narrow roads of the Swiss Alps, but for massive beauty the scenery to be enjoyed in a dozen trips in the State cannot be approached by the mountains of Europe.

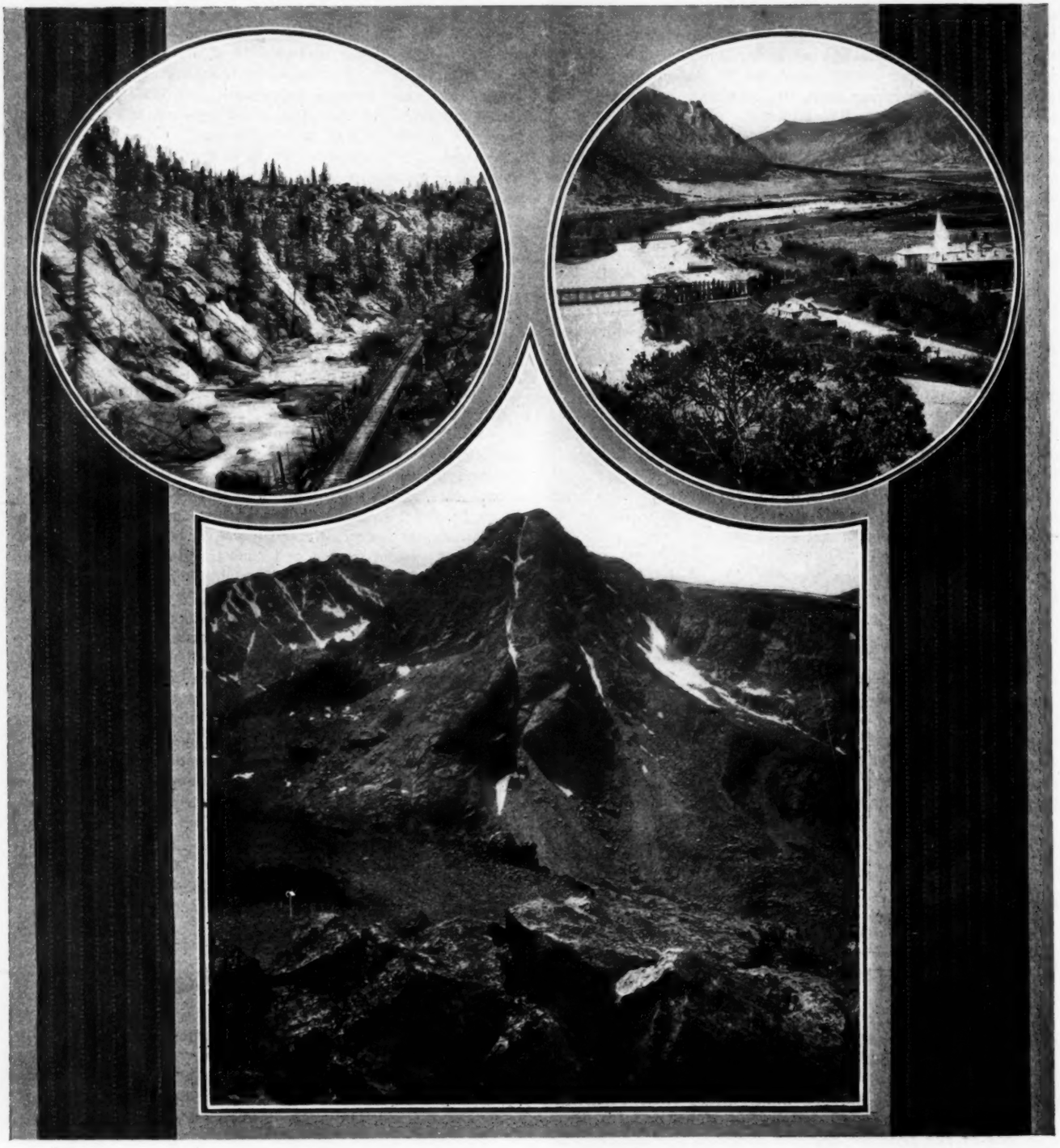
Transcontinental automobile tourists generally avoid Colorado and take routes through New Mexico or Wyoming in passing over the continental divide, and this seeming neglect of the State has given rise to the idea that it is impossible to traverse it in an automobile. This idea, however, is erroneous, and during the season of 1911 Colorado will be visited by a great army of tourists who have exhausted the pleasures of European motoring. This will be augmented by many automobilists who have not tried out the Swiss trails and the by-paths of the Pyrenees.

It has been said of Colorado that: "We could build a twenty-foot fence made of barbed wire around the State and never feel the need of climbing the fence or cutting the wire."

The answer to that is: "That may all be true, but you couldn't find timber enough for fence posts to support the wire if you scoured the whole State."

And, yet the answer is untrue, for Colorado has vast fields of timber and despite the fact that such a fence would require a staggering number of log feet, it is quite certain that there is enough and to spare for the purpose.

The State is a rectangular quadrilateral, 390 by 270 miles, and



Through the Granite Canyon Gorge, as wild a spot as exists in the State of Colorado

Glenwood Springs, Col. One of the highest watering places, in physical altitude, in the world

The Holy Cross Mount, a deeply seamed peak in which perennial snow traces the outlines of a rough cross

is almost equal in area to New York and New England. If the fence posts were placed twenty feet apart it would take 348,480 of them to carry the wire. If each was twenty-five feet long, the total number of log feet would be 8,712,000, representing the choice lumber on nearly 100,000 acres of land.

But Colorado would not think of going to that expense for that purpose, because its people do not wish to prevent tourists from visiting.

The State can boast, and actually does so with vehemence, of the most wonderful and varied scenery in the world. There are more different kinds of scenery in Colorado than the majority of Americans suspect of existence.

The eastern and western deserts, now rapidly taking the form of irrigated fields of intense richness, are not so spectacular, but vastly more unworthy scenes may be encountered than dawn or sunset of a cloudless June day on the plains near La Junta or back of Grand Junction. But the greatest charm of Colorado is her mountains. From the Sangre de Cristo range to Long's peak, which is in sight of the city of Denver, and from Sheep Mountain in the extreme northwest corner of Rout County to Sierra Blanca, with its deep purple shadows in the southeastern part of the State, is a wonder house. To-day it is perfectly feasible to traverse Colorado by several routes in a good car.

One beauty about automobiling in the Colorado mountains is

Where snow-clad Mount Sopris raises his head in majesty above those of his lowlier brethren

An unusual view of Pike's Peak, the giant outpost of the Rocky Mountains

The Seven Castles, a series of castellated cliffs, rising sheer from the sides of the canyon

that a considerable amount of exploration and pioneer work can be done. While a host of Americans have busied themselves in visiting Switzerland and other foreign countries they have overlooked Colorado to a considerable extent.

If there is anything in the world more inspiring and uplifting than the Colorado mountains, some of which are here pictured, it will be hard to find. It does not require the temperament of a poet or the ecstasy of the religieux to appreciate the majestic beauty of Mount Holy Cross. Standing in the presence of Nature in her grandest phase the plain ordinary citizen must feel the tug of emotion.

Those giant hills do not lend themselves as a stage setting for a joy ride. In the first place high speed would assuredly prove fatal and in the second the atmosphere of the mountains would convert the gayest roisterer into a thoughtful human being in less time than it takes to tell it.

Switzerland is great; the Pyrenees are picturesque; the mountains of Norway and Spain are rugged and the hills of Great Britain surprisingly precipitous, but the tourist does not have to cross the Atlantic to enjoy greater, more picturesque, more rugged and precipitous settings for an automobile tour than are afforded abroad. Right here at home they can be found and a tour of Colorado answers the question. The Touring Club of America is engaged in planning such tours.

In the Tempering of Steel

What to Do to Obtain Efficiency

Success, in the tempering of steel, according to E. F. Lake, depends upon a close observance of all of the conditions that are known to be efficacious, taking into account the nature and the characteristics of the steel, previous history and the work that the steel is to do after it is put to work. The equipment required in the process may be simple or elaborate as the amount of work to be done would suggest, but the process must be regulated, and, as the story goes, this is a matter of knowing how to perform the several operations, knowing the reason why, in each instance—simple statements of the groundwork are given in the story.

UNDERSTANDING that the positive quenching that is given steel when hardening it increases the tensile strength and elastic limit and reduces the elongation and resistance to shock in the same ratio, it will be appreciated that the resistance to shock and elongation are reduced to so low a point that the steel easily breaks when submitted to such strains as are given the moving or stationary parts of an automobile. It is therefore necessary to reheat the steel and thus draw out part of the hardness given by hardening. By varying the temperature at which the steel is reheated it can be given its highest possible elongation, resistance to shock or reduction of area. This, however, is always accomplished at a sacrifice of the tensile strength.

Engineers or designers should have positive data as to the heat-treatment given the parts of a car that are made of steel in order to know what size and shape is best for these parts. The temperature at which a piece should be raised for tempering depends on the use to which it is to be put, the condition in which it has been left by quenching, and the composition of the metal. This temperature should be maintained only long enough to assure an even heating of the piece.

The austenite which has been retained in the steel by the sudden cooling when hardening has a natural impulse to change into pearlite. Slightly reheating the steel after hardening will lessen the molecular rigidity set up by the hardening process and give freedom to the molecular change. The higher the temperature is carried in the reheating the more it will lessen this molecular rigidity and the more will the austenite give way to a pearlite formation.

In heating steel to 150 deg. F. a slight tempering will take place, but if the temperature is raised to 450 deg., at which point iron oxide first makes its appearance on a polished surface and gives the metal a straw color, a more decided tempering will result. The temperature at which this oxide assumes a permanent blue color is 575 deg. F. and here a still greater tempering is given the metal. Each increase in this temperature of reheating reduces the hardness and brittleness and the tensile strength and elastic limit and increases the elongation, resistance to shock and reduction of area. This is well illustrated by the tabulated results in Table I.

In judging the tempering steel by the colors mentioned above, however, it is very essential that the carbon contents of the metal be known, as this greatly alters the color that is given to steel by a certain degree of temperature. As an instance of this a carbonized steel with the outer shell containing from 1.00 to 1.10 per cent of carbon was tempered so the color showed purple on this outer shell; the center, or core, which had a carbon content of from 15 to 30 per cent., was then a dark straw color. Various combinations of the purple and blue shades on the outer shell with the straw and brown shades in the core can be obtained with carbonized steel by tempering it at different temperatures. These show the great effect that carbon has on the color of tempered steels.

Balls used in ball bearings are usually reheated to about 350 deg. F. for tempering. Leaf springs for motor cars are usually reheated to about 800 deg. F. Gears that are in constant mesh, without any undue pressure, will give the best results as to elastic strength and resistance to shock if heated to 675 deg. F. Crankshafts of internal-combustion engines will much better withstand the torsional, vibrational and impact strains and stresses put upon them if reheated to about 1,000 degrees.

In Chart I (on page 1049, issue of May 4) is shown the load in pounds and deflection obtained on leaf springs that were hardened and tempered at the proper temperatures. Numbers 1-2-3 are alloyed steels, while numbers 4-5 are ordinary carbon steel. In number 2 the elastic limit was reached, and consequently the metal was destroyed for any use as a spring.

Various methods are employed for heating steels up to the proper temperatures for tempering. For ordinary work, where one or two pieces are to be tempered, they are usually heated in an ordinary forge fire or furnace oven and judged by color. Where many pieces of a kind are tempered and accurate results are desired the oil, lead and salt baths are resorted to to obtain the desired heat in the metal.

Temperatures up to 600 deg. F. can easily be obtained with the oil bath, and some of the tallows can be successfully worked at temperatures as high as 800 degrees. When these points are passed, however, the flash point is reached and they burn. The metal is not injured by soaking in them for any length of time, providing the tempering temperature is not exceeded, and this doubtless makes them the best bath for tempering, where they can be used. They are easily heated with fuel oil, gas or electricity, and thus a constant temperature is easy to maintain.

Salt baths are of low cost and are very useful for drawing temperatures between 575 and 900 deg. F. Salt cannot be used below 575 deg. F. because it is then in the solid state and does not become a liquid until this temperature has been reached. After 900 degrees has been passed it volatilizes, and consequently its usefulness is destroyed. When cold steel is inserted in the salt bath it causes the salt that comes in contact with it to solidify, and this white crust can be plainly seen when the piece is in the bath. When the crust disappears it means that the metal has assumed the temperature of the bath, and it can then be withdrawn and cooled.

TABLE I.—EFFECT OF HARDENING AND TEMPERING ON STRENGTH OF STEEL.

	Annealed at 1375° F.	Quenched in Oil at 1650° F.	Reheated and Tempered at 450° F.	500° F.	600° F.	800° F.	1000° F.	1200° F.
Tensile strength, lbs. per square inch	87,500	232,500	212,000	147,000	138,000	130,500	127,500	125,000
Elastic limit, lbs. per square inch	64,500	224,000	200,000	145,000	127,500	124,000	110,000	103,000
Elongation, per cent. in 2 inches	29	11	12	17	18	17	20	21
Reduction of area, per cent.	59	39	51	57	65	62	58	56

The lead bath can be used for drawing metals at all temperatures from the hardening heat down to 620 deg. F., below which point the lead assumes the solid state. By mixing tin with the lead, however, temperatures as low as 300 degrees are easily obtained before the metal becomes a solid. Table II gives the combinations of lead and tin that can be used for various temperatures down to 450 deg. F. Owing to the wide range of temperatures that the lead bath has and the ease with which a lead pot can be heated by either coal, coke, oil, gas or any other fuel, it is used to a very large extent for tempering steels as well as for hardening them.

TABLE II.—COMBINATIONS OF LEAD AND TIN THAT MELT AT VARIOUS TEMPERATURES.

Pure lead melts at				619° F.
200 Lbs.	lead to	8 lbs.	tin melts at	560° F.
100	"	"	"	550° F.
75	"	"	"	540° F.
60	"	"	"	530° F.
48	"	"	"	520° F.
39	"	"	"	510° F.
33	"	"	"	500° F.
28	"	"	"	490° F.
24	"	"	"	480° F.
21	"	"	"	470° F.
19	"	"	"	460° F.
17	"	"	"	450° F.

It will thus be seen that the temperature is easily obtained at which it is desired to temper steels, and the only part of the work that is up to the engineer is a knowledge of the correct temperatures at which to draw the various parts for the best results.

Motored Across East Africa

Five Germans, after a hard battle lasting for nearly two years, accomplished the task in the face of almost insurmountable difficulties.

LIEUTENANT GRAETZ, with two friends and two chauffeurs at various stages, has accomplished the feat of crossing German East Africa, and going quite a distance into German Southwest Africa in an automobile. The party experienced all sorts of difficulties and many of them, after starting on their tour from Dar-es-Salaam. One of the first mishaps to befall them was the bursting of the cylinders as they attempted to ford the Ugomberenga River, the accident having resulted from sudden contact of the over-heated cylinders with the water of the stream. The chauffeur was dispatched to Germany for new cylinders. While in that country something happened to the chauffeur and he sent another chauffeur back to Africa to fill his place. The delay tied up the journey for a period of four months, at the end of which the tour was resumed and continued successfully for some time.

The natives gave a hand now and then in the work of blazing paths through the country, dynamite often being used. It was found necessary to cross 28 rivers within a stretch of 69 miles. Occasionally it was necessary to build rafts and bridges, pressing dugouts and other material into service. A posse of 50 negroes was drafted in at one point for the purpose of transporting the motor car. The fact that crocodiles were numerous and none too friendly in the streams did not lessen the difficulties of travel, in the event of fording streams. The natives looked upon the automobile from every sort of angle between awe and surprise, applying to it the names of "Devil's carriage," and "Wind wagon." A section of the country lying between Kilimatinde and Tabora, which the caravans occupy 15 days in spanning, was made by the Graetz party within a space of two days. When they got into a stretch of British territory, they received encouragement from British officials, farmers and missionaries. But a new trouble came to the party as they crossed Northwest Rhodesia. Here the couriers, fancying the benzine to be water, spilled it on the ground, claiming that it constituted an unnecessary burden. The travelers then proceeded over the Kalahari Desert, and at the end of 630 days from the time of setting out from Dar-es-Salaam reached Swakopmund, in German Southwest Africa.

It Stands to Reason—

Aphorisms, apropos of the automobile, of seasonable portent, hitting at abuses and amplifying uses.

THAT the aperture of the ego is the eye of the egotist.

THAT an optical illusion distorts the ego.

THAT some chauffeurs see double.

THAT intending purchasers seek qualities that do not reside in the cars of their choice.

THAT salesmen are too frequently troubled with an overgrown perspective.

THAT designers are inclined to be blind to the faults of their children.

THAT a rural constable is enabled to see speed in a snail, if an automobile number plate is appended to its façade.

THAT law-makers look through a cracked china eye.

THAT some automobilists think they have their eyes in their feet—they kick the tires to see if they are inflated.

THAT our old friend, exaggerated ego, must have taken up his abode in the City Hall, New York—the chuckholes in the streets are of exaggerated area out of pure sympathy.

THAT it is difficult to see a diminutive runabout coming down the road if it sports a 20-inch headlight.

THAT it is equally difficult to discover good taste as an attribute of the man who wants so much light on such a small subject.

THAT the second-hand problem is being complicated by the very men who have the most to lose in the process.

THAT dealers will lose dollars on second-hand automobiles if they continue to disregard common sense.

THAT the philosophy of uncommon dollars and common sense teaches the necessity of selling new automobiles for real money.

THAT the customs of to-day will be the laughing-stock of to-morrow—it is this truth which tells us that finality in automobile designing is not yet.

THAT a man can make a fortune attending to his own business—the world is full of fortuneless men.

THAT the best gun is knowledge—on this basis the automobile business is in need of armament.

THAT there is a thread here and there in the automobile business that we have not grasped.

THAT the ruffled composure of a motor indicates lack of nourishment.

THAT strange and sinister happenings to an automobile usually come from a blank mind.

THAT disarranged plans are due to lack of foresight.

THAT a mystery in a motor generally resides about a mile inland, as it is viewed by the new owner.

THAT the convulsive quiver of a dying motor is the last call to the chauffeur to turn on the "gas."

THAT it is a singular shot in the investigation of motor trouble when the investigator allows a look of grim humor to take complete possession of his face.

THAT the most extraordinary and tragic affairs occur just around the bend of a good road—the driver trusts to luck once too often.

THAT the iron constitution of a good motor will be too soon undermined by a chauffeur who knows that the motor is working all right if it don't fall apart when he "races" it.

SUCCESSFUL TEST WITH SOLID GASOLINE.—An automobile has just been driven from London to Brighton propelled by simply the amount of petrol which the chauffeur carried in a small box, at the side of the car. The petrol was solid in form, having been in blocks about 2 inches square. But these lumps represented 40 gallons of petrol in its liquid state. It burned with no more combustion than a candle. The composition, at least of some of its composite parts, is a secret.

Trap the Liquid Out of the Mixture

Editor THE AUTOMOBILE:

[2,648]—My motor performs badly at times, due to the fact that liquid gasoline trains into the air in excess quantity, and I suspect that it gets into the cylinder and induces a crop of carbon, which ultimately ends in the cranky performance of the motor. I have adjusted my carbureter to the best of my ability, and I am satisfied that it does very well in the main; moreover, I am not sure that any other make of carbureter will accomplish the end more satisfactorily in view of the fact that stove gasoline is about all that I can get in my country. I have a little shop, and I am willing to go to work. Will you tell me what to do? COWBOY.

Tucson, Ariz.

The gasoline that you are evidently getting is made up of some hexane, to which is added heptane, octane, perhaps nonane, and, more than likely, a dash of decane. The hexane will vaporize all right; the heptane resists a little; the octane volatilizes poorly in automobile work, and as for the nonane and decane, we tried some of it in a tub, and after lighting a newspaper and throwing it on top of the liquid in the tub, it put the fire out. To whatever extent the heavier constituents obtain in the stove gasoline that you use they will have to be trapped out, or, as you say, you will reap a crop of carbon in the combustion chamber of the cylinders of the motor. Fig. 1 shows a trap in section in the intake manifold, which will explain itself. Make a trap of this kind, and try it out. In addition to this plan, heat the gasoline as it oozes out of the nozzle of the carbureter.

Garage Washroom Sink Stops Up

Editor THE AUTOMOBILE:

[2,649]—I operate a good-sized garage, and having used a washstand sewer-syphon (which was previously illustrated in THE AUTOMOBILE) with good satisfaction, I am led to believe that I can get from you an idea that will solve the washstand problem, which is much more serious than the average man would suppose. The grease and other substances that accumulate in the washstand stop up the "rose" connection, and the workmen, who are not always precise, go away leaving the water turned on, and the building is flooded every little while. What would you suggest as a remedy?

Chicago, Ill. PROGRESSIVE.

The scheme as shown in Fig. 2 may be of use to you. According to this plan, the "rose" plate is screwed out of the bottom of the basin, and the new attachment is substituted in its stead. This attachment is composed of a shell, which is flanged over to fit in place of the "rose" plate, and a strainer, with a beveled flange meeting a bevel on the shell, is dropped down into the cavity as shown, the idea being to accumulate all of the refuse in the strainer, which can be lifted out when the occasion requires, and after it is cleaned it may be put back again, thus preventing this insoluble matter from entering the system below.

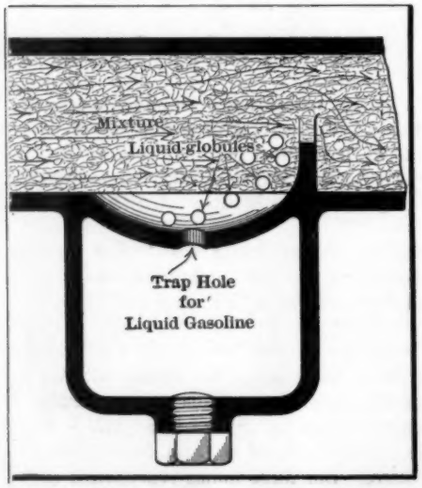


Fig. 1—Section of a trap in the intake manifold designed to catch the non-volatile liquid, preventing it from going into the combustion chamber, where it will crack and grow a carbon deposit

Duryea Again Objects

Editor THE AUTOMOBILE:

[2,650]—I have just read with some merriment the able argument of "Automobilist" on pages 1014 and 1015 of the April 27 issue. I would not bother to reply were it not that this may mislead well-meaning people by the apparent sincerity of the writer. It reminds me that Lord Kelvin only a few years ago would not join the British Aero Club because he could see no hope for its objects; and that only a few years earlier scientists gravely told us flying was impossible because mathematics proved it. The big bird increased its weight as the cube of its size, whereas the wings only increased as the square. Less than 100 years ago a certain bright mathematician proved by his figures that no auto could climb a certain hill near London, but before the essay had gotten off the press Sir Golsworth Gurney had driven one of his crude steamers to the top.

Josh Billings wisely remarks: "It is better not to know so mutch than to know so mutch that ain't so." I do not know what sort of oil "Automobilist" used in his experiments, but I advise your readers to think twice before believing that a drop of it will float on a standpipe full of gasoline and plug the spray outlet. Down in this part of the world the cylinder oils we use are heavier than gasoline and sink to the bottom until thoroughly mixed, after which they do not separate until the gasoline evaporates. These facts prevent such an imaginary happening as is pictured.

What Some Subscribers Want to Know

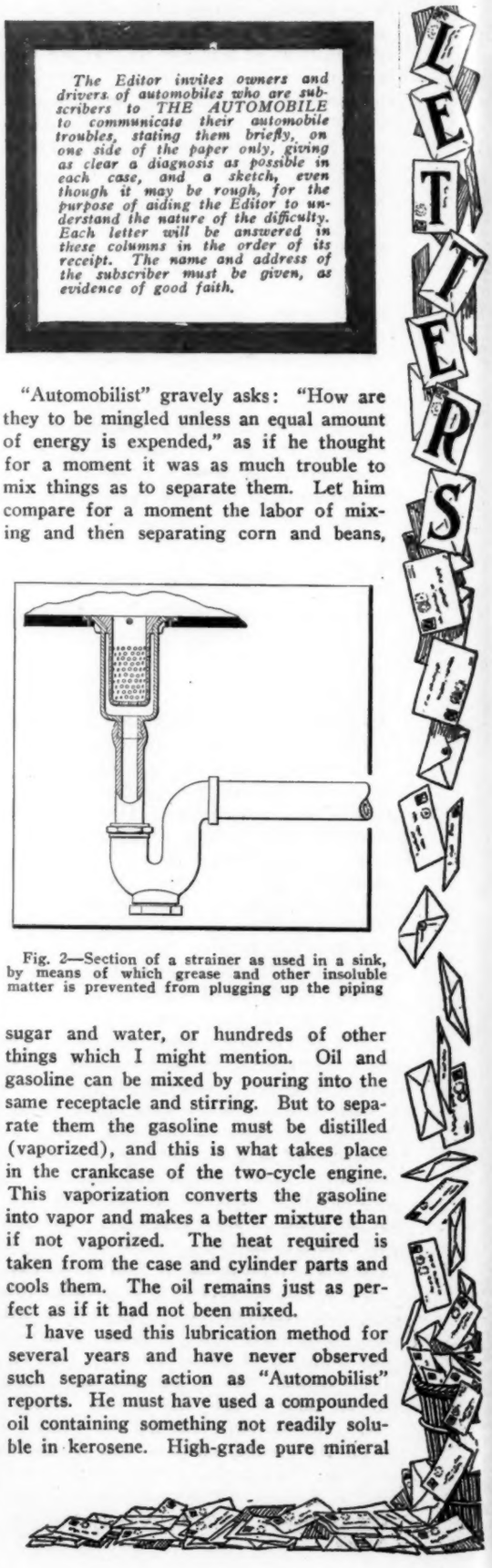
The Editor invites owners and drivers of automobiles who are subscribers to THE AUTOMOBILE to communicate their automobile troubles, stating them briefly, on one side of the paper only, giving as clear a diagnosis as possible in each case, and a sketch, even though it may be rough, for the purpose of aiding the Editor to understand the nature of the difficulty. Each letter will be answered in these columns in the order of its receipt. The name and address of the subscriber must be given, as evidence of good faith.

"Automobilist" gravely asks: "How are they to be mingled unless an equal amount of energy is expended," as if he thought for a moment it was as much trouble to mix things as to separate them. Let him compare for a moment the labor of mixing and then separating corn and beans,

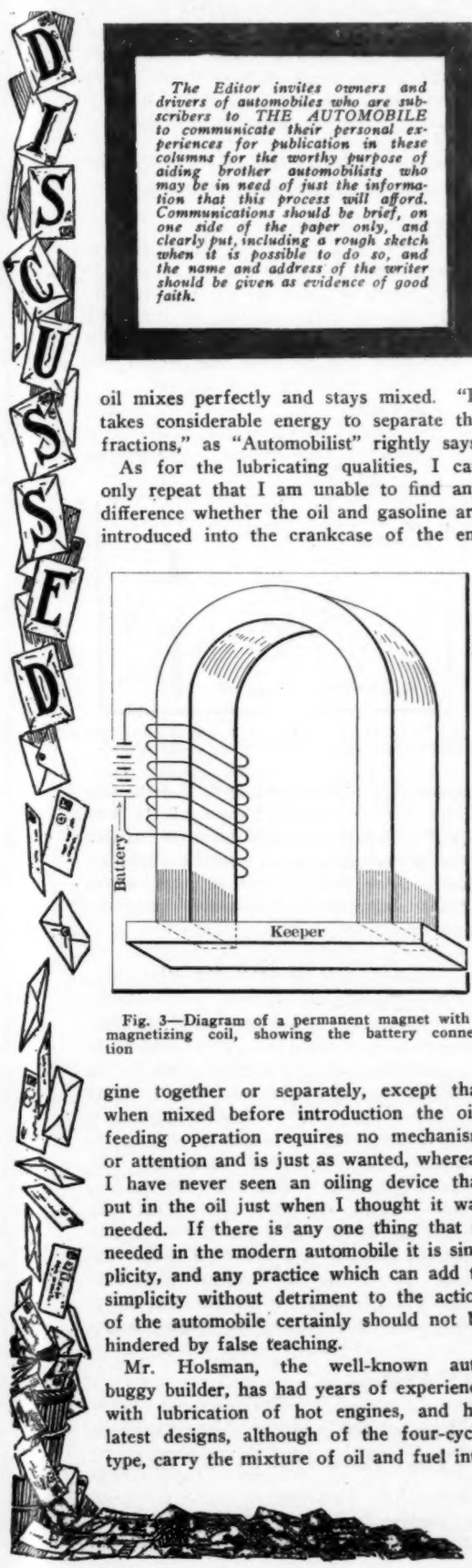
Fig. 2—Section of a strainer as used in a sink, by means of which grease and other insoluble matter is prevented from plugging up the piping

sugar and water, or hundreds of other things which I might mention. Oil and gasoline can be mixed by pouring into the same receptacle and stirring. But to separate them the gasoline must be distilled (vaporized), and this is what takes place in the crankcase of the two-cycle engine. This vaporization converts the gasoline into vapor and makes a better mixture than if not vaporized. The heat required is taken from the case and cylinder parts and cools them. The oil remains just as perfect as if it had not been mixed.

I have used this lubrication method for several years and have never observed such separating action as "Automobilist" reports. He must have used a compounded oil containing something not readily soluble in kerosene. High-grade pure mineral



What Other Subscribers Have to Say



The Editor invites owners and drivers of automobiles who are subscribers to THE AUTOMOBILE to communicate their personal experiences for publication in these columns for the worthy purpose of aiding brother automobilists who may be in need of just the information that this process will afford. Communications should be brief, on one side of the paper only, and clearly put, including a rough sketch when it is possible to do so, and the name and address of the writer should be given as evidence of good faith.

oil mixes perfectly and stays mixed. "It takes considerable energy to separate the fractions," as "Automobilist" rightly says.

As for the lubricating qualities, I can only repeat that I am unable to find any difference whether the oil and gasoline are introduced into the crankcase of the engine together or separately, except that when mixed before introduction the oil-feeding operation requires no mechanism or attention and is just as wanted, whereas I have never seen an oiling device that put in the oil just when I thought it was needed. If there is any one thing that is needed in the modern automobile it is simplicity, and any practice which can add to simplicity without detriment to the action of the automobile certainly should not be hindered by false teaching.

Fig. 3—Diagram of a permanent magnet with a magnetizing coil, showing the battery connection

Mr. Holsman, the well-known auto buggy builder, has had years of experience with lubrication of hot engines, and his latest designs, although of the four-cycle type, carry the mixture of oil and fuel into the crankcase, where the gasoline is vaporized largely, leaving the oil, after which he pipes out of the case and to the inlet valves at the cylinder head in the usual manner. I look to see this practice grow in use simply because it does oil and cool and saves oiling mechanism.

CHAS. E. DURYEA.

Thomas A. Edison advocated water as a lubricating medium for bearings upwards of twenty-five years ago. The editor of THE AUTOMOBILE witnessed the performance of water on dynamo bearings under the Edison plan at Elgin, Ill., at that time. The dynamos ran, doing good service, and the saving in the oil bill was considerable, but it was true of this plan, nevertheless, that it lacked the principle of insurance, and in the absence of this principle a high-priced workman stood around watching the bearings for fear they would get hot. This workman cost several times the saving of lubricating oil, and the plan was ultimately abandoned because the insurance feature was missing.

Re-magnetizing Proposition Offers No Great Difficulty

Editor THE AUTOMOBILE:

[2,651]—My magneto worked very well for two years, excepting that toward the tail end of the performance the spark weakened and I suspected that the magnets were dying out, but I now know that they are so weakened that the magneto is a poor substitute for a sparking equipment, and the question is, can I re-magnetize the horseshoe magnets, or must I send them to the maker?

New York City. K. C. S.

Back off the holding screws and remove the magnets from their resting place, after which take a few turns of No. 18, Brown & Sharpe's gauge, insulated copper wire (Fig. 3), connecting the two ends of the same up to a storage battery, thus passing a considerable current in amperes through the turns of wire, thereby inducing a magnetic flux in the horseshoe magnets. Repeat the performance several times, and in breaking the connection draw the wire slowly away from the terminal in each case, in order that the current will die down from its maximum to zero at a slow rate. There is no mystery attached to this process; in fine, you cannot prevent the magnetization of the horseshoe magnets if you proceed in this way, but the strength of the magnets will be improved as the result of several applications of the current.

A Fan Would Obstruct the Exhaust of the Motor

Editor THE AUTOMOBILE:

[2,652]—I have read in THE AUTOMOBILE matter in relation to back-pressure of motors, and I get the impression that an exhaust fan placed in the pipe leading to the muffler would overcome this difficulty. My idea is to apply this scheme to a two-cycle motor. NOVICE.

Boston, Mass.

The present difficulty, as it is experienced in two-cycle motor work among those who are lacking in skill, is to realize a fair condition of scavenging. The time available for the escape of the exhaust product is relatively short. A fan placed as you suggest, which is illustrated in Fig. 4, would serve as an obstruction and nothing more. The velocity of the exhaust products of combustion under the terminal pressure as it obtains in practice is far greater than the velocity of the fan blades, which is another way for saying that you might just as well drive a cork in the muffler orifice, puncturing a few holes in the same in order that some of the exhaust products will get out, thus preventing the motor from shutting down entirely.

Depends upon the Road and the Driver

Editor THE AUTOMOBILE:

[2,653]—As a subscriber and reader I would like to ask your expert which engine will handle a car the easiest and nicest, a six-cylinder or a four-cylinder, providing they both figure the same horsepower.

Waterloo, N. Y. F. G. STEWART.

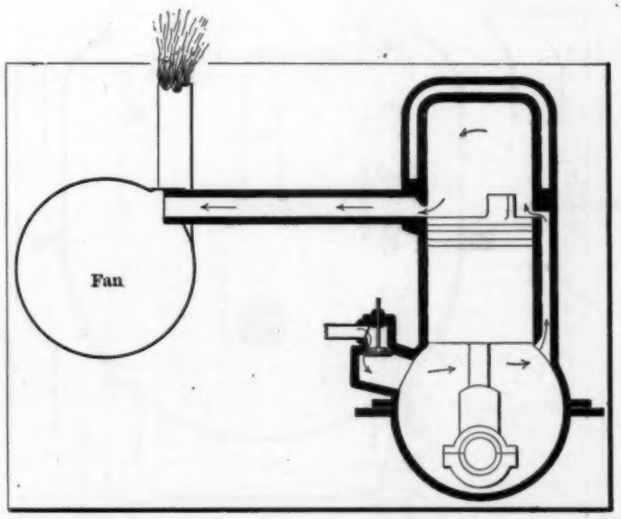


Fig. 4—Section of a two-cycle motor, illustrating the idea of using a fan in the exhaust system for the purpose of scavenging, which fan, however, would serve as a mere obstruction

Your question seems to have for its purpose the bringing out of a definite opinion as to the relative virtues of four-cylinder against six-cylinder motors. It is not in keeping with progress to close the door against one of two types of motors when both of them are serving in their respective fields to the entire satisfaction of users. A four-cylinder motor delivering the same power as a motor having six cylinders will produce the greatest starting torque, because the torque is proportional to the square of the diameter of the piston, and the four-cylinder motor will have the largest diameter piston under the conditions named. If the four-cylinder motor is provided with a sufficiently large flywheel, the inequalities of torque will be ironed out, this being the function of the flywheel. The six-cylinder motor will deliver 50 per cent. more torquing impulses per minute, and the flywheel, under the circumstances, is not required to iron out the same number of inequalities of torquing moments, remembering that it is the mean torque that makes the automobile go. How fast an automobile will travel under a given set of conditions is a problem that has to be solved on the same basis for either of these motors, and you can best judge of results by consulting racing records as they obtain through a decade of time.

Fitting an Oil Level to the Base Chamber

Editor THE AUTOMOBILE:

[2,654]—I have from time to time seen that you publish sketches in your paper in connection with attachments to existing cars, and would like to trouble you, being a subscriber to your paper. The oil filler on my car is very small and I spill oil every time I pour it in; there is a plunger pump that seems to work satisfactorily, but I have not looked at it and do not know how it works. How can I fit a sight oil level to determine the quantity of oil there is in the base chamber?

Boston, Mass. LUBRICATION.

The conventional oil pump of the plunger type will be seen by referring to Fig. 5, and as a suggestion for a filler the one there shown should answer your purpose. If space does not permit, the size of the piping can be reduced. The method often employed by makers for determining the oil level is shown on the right-hand side of the picture. At the lowest point of the base a flange is fitted to accommodate an elbow; to this is fitted a pipe about 1 1-2 inches in diameter, and a continuation to this slightly smaller in diameter in the manner shown. In the larger pipe is placed a cork float, to which has been attached an upright wire carrying a ball S at the top. G1 represents a glass insetted inside the tube C so that the ball S can be readily seen.

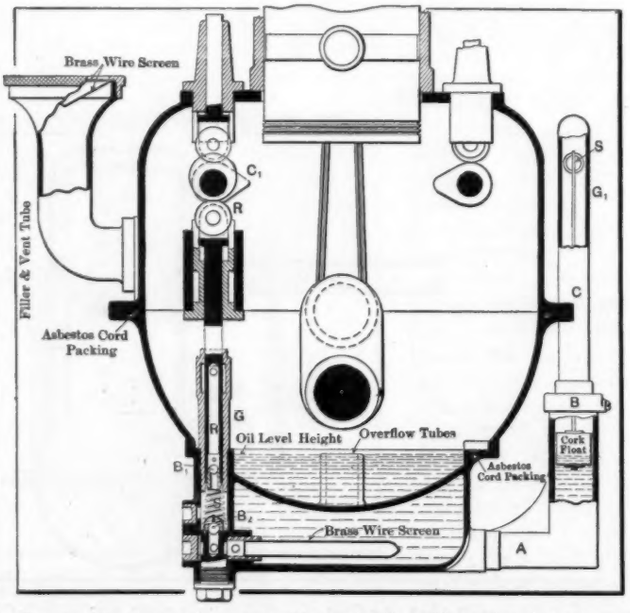


Fig. 5—Oil scheme of a motor with the detail workings of a plunger pump and method of fitting an easily read oil level

Easiest Way Is to "Spin" the Motor

Editor THE AUTOMOBILE:

[2,655]—With the dry cells entirely out of commission, or master vibrator not working, is it possible to start on the magneto and what is the easiest and simplest way? My car is fitted with dual ignition. Is it not possible to make a rich mixture, open the relief cocks to relieve compression, and make "spinning" easier, and start on the magneto without assistance from the supplementary ignition system, and without the arduous labor that spinning the magneto under full compression would entail?

OWNER AND DRIVER.

Jacksonville, Fla.

The proposition as here stated reduces the starting problem to the spinning of the motor with the compression relieved, using the magneto only for ignition purposes. The ease or difficulty to be encountered depends upon the good working qualities of the carbureter and the skill of the driver to be displayed at the time of shutting down the motor. If in stopping the motor the control system is so manipulated that the mixture remaining in the cylinders will be well balanced, the effort required after the compression is relieved will be slight, due to the fact that the mixture will ignite and burn readily, and a good magneto will surely deliver a spark if the spinning of the motor is smart. Just turning the motor over slowly is not likely to produce the desired result. One quick twirl of the crank-shaft is worth a half an hour of slow cranking.

Method of Fitting Electric Side Light Flush with the Dash

Editor THE AUTOMOBILE:

[2,656]—Will you please explain through your "letters answered column" how I can fit countersunk electric sidelights on my car? The dash is fairly high and is fitted with a curved cowl. I think that if the lights were flush with the dash they would look better than stuck out on a bracket.

Red Bank, N. J. R. F.

The method shown in Fig. 6 should be a solution of your problem. The general

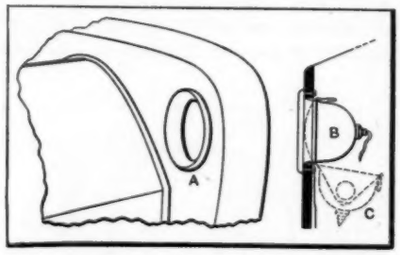


Fig. 6—Showing a dashboard with electric side lamps fitting flush and the method of fitting same

appearance will be seen at A, and the side view with the cowl removed will be seen at B. Provision should be made so that the lamp hinges at the rear to obtain access to the bulb in case it gives out or breaks, but this is not absolutely necessary.

"To Slip or Not to Slip"

Editor THE AUTOMOBILE:

[2,657]—Will you please settle an argument for me? A says a disc clutch can be slipped best: B says a cone clutch can be slipped to greater advantage. Who is right?

Allenhurst, N. J. ELMISA ZEHNDER.

The clutch is not made to slip and in neither case is there any advantage. The car is fitted with sliding gears for the purpose of easing the clutch and it is the judicious use of the gears that has to be considered and not how much the clutch will slip. In the case of a leather-faced cone clutch if it is slipped it will burn out and in the metal disc variety the edges become "frayed" and the next stage will be the repair shop.

Wants to Know About Tires That Blow Out at the Bead?

Editor THE AUTOMOBILE:

[2,658]—I wish you would please answer the following questions:

1. The bead on one of my tires has been stretched to the extent that a tube often blows out where the tube comes in contact with the rim. How can I fix it?

2. When the motor is running there is a continuous vibration of the whole car. I think the ignition is out of time; if not that, it might be the valves. How can I time either the ignition or valves on engine with an L-shaped cylinder? The valve in the head of cylinder is exhaust. The car has only a magneto (Splitdorf) and no battery.

3. I am puzzled to know how to put the ball bearings in my rear wheels. They are held together in a ring. Should they be placed as shown in Fig. 7, or should they be turned round, *i. e.*, side B placed toward wheel? Thanking you in advance.

White Hall, Ill. ARNOLD V. MORROW.

1. It would seem that the cause of the trouble lies in the rims, which probably have become flattened. Unless the tires fit snugly in the rims the gap that forms

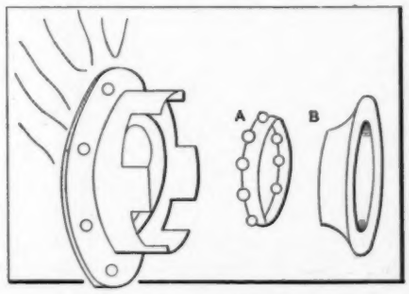


Fig. 7—Showing the back wheel of a car with the ball race removed

pinches the inner tube when any side thrust is put on the tire such as going round a corner, and on straightening up again the tube must split. Have the rims seen to.

2. There is no difference in timing a motor with an L-shaped cylinder or the ordinary T-shaped type. The flywheel on most cars is marked for the purpose of setting the valves and the magneto. An extensive set of instructions appeared in last week's AUTOMOBILE with reference to timing. If you have further trouble we should suggest your writing to the factory where the car is made as they may have a special timing for the particular motor.

3. From your sketch it would appear that the correct way would be with the side A toward the wheel. The main point is that the balls run in the race-way and that the cage fits into a recess.

Another Method of Tire Testing

Editor THE AUTOMOBILE:

[2,659]—I was very interested in an article that appeared in last week's issue of your paper with reference to the method of testing tires by means of imprint on a whitewashed surface of the garage. My garage is rather greasy, which I assure you is not from choice, as it is washed regularly, but the floors are made of wood and the accumulation of several years has saturated the wood to that extent that it will not come out. I contemplate placing several taxicabs on the street and would like to have your opinion with regard to the inflation of the tires. Is it not possible to rig up some permanent means whereby a bell would ring if the tires were underinflated? I shall be very grateful if you can help me, and if possible show how it can be effected with a sketch.

New York. GARAGE OWNER.

It should be possible for you to effect a means of telling if the tires are inflated by the amount of flexure due to underinflation. This is the means used in the imprint test. A permanent fitting could be made in the manner shown in Fig. 8. On the left of the illustration you will see a car about to pass through a double neck, which will guide the wheels. The tires should squeeze slightly as they pass through the points M and M1. If they do not, it is easy to find the reason, as the wheels will not be in proper alignment. After leaving the points M and M1 the tire will flatten at H and H1 under the load, and the striking bars should be set for the amount of flexure allowed when the tire is properly inflated. The method of determining flexure was given in detail some time ago in THE AUTOMOBILE. Just what takes place when the tire strikes the bar will be seen by referring to the B in Fig. 8. The striking bars are held in pivot arms with a spring between them to keep them together, the actual space being predetermined. If the tire is underinflated it will force the striking bars away from one another and the bases will form contact below the ground surface in the manner indicated. With an electric bell and batteries in circuit, the moment the contact is completed the bell will ring, telling the chauffeur that the tires require more air. In the case that different size tires are used on the cars, a series of striking bars suitable for the diameter can be added.

Experienced Automobilists Tell About Reliners

Editor THE AUTOMOBILE:

[2,660]—Having had some experience with reliners or inner tube casings, would say to E. C. B. No. 2,541: If your casings are in good condition, do not put anything in them, as reliners tend to make tires heat up and lose in buoyancy, but if casings are getting weak or badly worn, reliners will add to their mileage and prevent blow-outs. Do not use a reliner that is cemented to stick to the inside of the casing, or it will loosen the inside pieces of the fabric and damage the casing. I think for old or worn casings, reliners will prove a good investment.

REPAIRMAN.

Cherry Creek, N. Y.

Air Costs Nothing—Why Pay for a Filler?

Editor THE AUTOMOBILE:

[2,661]—Being a subscriber to your paper I would like to know if you can give me any information in regard to the filling of the inner tubes with something like rubber, but perfectly soft, and they claim in riding the car it is impossible to tell it from air.

A salesman is here with a sample from a tire that has run two years in Denver, and claims there is no hardening of material. Please advise me if this is a success, and if so, what is the name of a reliable company?

Salem, S. D. O. ARNOLD.

Unless it can be shown that the proposed filler is more efficacious for tire purposes than air it is difficult to imagine a reason why the filler should be purchased at a price, since there is plenty of air lying around loose, and to be had at the cost of a little pumping.

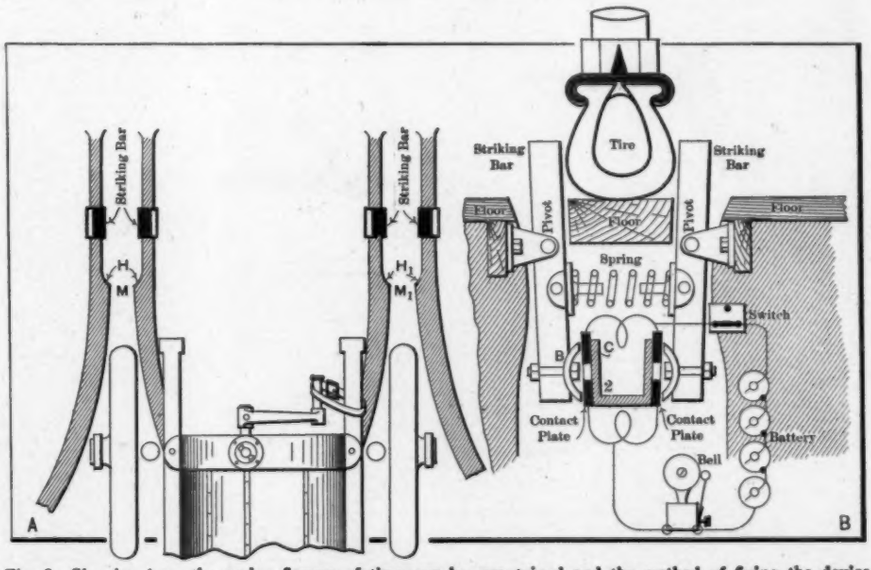


Fig. 8—Showing how the undue flexure of tires can be ascertained and the method of fixing the device together with electrical connections

Meeting Recurring Troubles

Presenting a Series of the Most Probable Cases

A series of co-related short stories, accompanied by diagrams and characteristic illustrations, indicating the nature of the troubles that are most likely to happen to automobiles, discussing their causes and effects, all for the purpose of arriving at a remedy. It is the aim, for the most part, to show how these troubles may be permanently remedied, and as a secondary enterprise it is indicated how the automobilist can make a temporary repair, thereby enabling him to defer the making of a permanent repair until a convenient time arrives.

WHEN THE SPARK PLUGS FAIL IN SERVICE—To lay it upon the spark plug is natural, but it is futile unless the claim is well grounded. Quite frequently the difficulty is to be traced to the method of the use of these important equipments. Fig. 23 shows how the spark plugs should be screwed into the cylinders, referring specifically to the distance in that the plugs should go. In this example the length of the threaded portion of the plug checks up with the thickness of the wall of the plug into which the plug goes. The best results come when the spark plugs are so made that a shoulder is placed at the termination of the threading, leaving room for a metal-armored gasket, and when the plug is fetched home the shoulder will press the gasket against the faced-off boss of the cylinder or cap designed for the accommodation of the spark plug. For the benefit of those who may not have given the matter attention, the A. L. A. M. standard of spark plug is here reproduced, in which Figs. 24 and 25 are of the plug, and referring to the letters on the cut, they are explained as follows: The spark plug adopted as a standard has a ⅞-inch diameter, straight thread, 18 pitch, and the design and dimensions shown in the following specifications: A, 1⅛ inch; B, ⅞ inch; C, ⅛ inch; D, ⅞ inch; E, not less than ½ inch; F, not more than ⅛ inch (depth of recess, not over depth of thread); H, ¾ inch. SPECIFICATIONS—*Stock*, 1⅛ inch round. *Head Form*, milled hexagonal; short diameter, ⅞ inch. *Flange Form*, circular; diameter, 1⅛ inch; thickness, ⅛ inch; face, annular seat ⅛ inch wide. *Blank for Thread*—Diameter, ⅞ inch; length, not less than ½ inch. *Recess Adjacent to Flange*—Width, not over ⅛ inch; depth, not over depth of thread. *Thread Diameter*—⅞ inch straight; pitch, 18 inches; form, U. S. Standard; cut, perfect into recess. *Packing-Gland Nut Head*—Form, hexagonal; short diameter, ¾ inch.

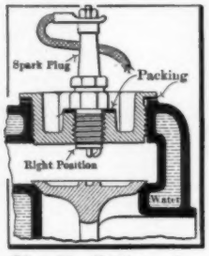


Fig. 23—Section of a cylinder through a valve showing the spark plug in the cap screwed in flush with the inner face

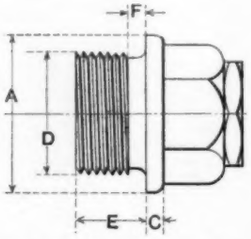


Fig. 24—Diagram of the threaded part of a spark plug, with reference letters to accord with the A. L. A. M. standard

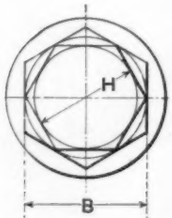


Fig. 25—Plan of the A. L. A. M. spark plug standard diagram used in connection with Fig. 24

There is something to be said in favor of the use of suitable grades of material in this work, it being the case that cold rolled steel and other ordinary stock of which bolts are frequently made are too high in sulphur and phosphorus to be regarded as reliable and the Society of Automobile Engineers is undertaking to recommend the type of fabric that will be most efficacious in this service. As a general proposition, Bessemer bars should not be used, and confining the selection of material to nothing more inferior than basic open-hearth steel, it still remains to regulate the carbon content.

It is true that there are quite a number of motors running that do not adhere to the standard, but this must be regarded in the light of a misfortune, it being true that a motor is of no value if it will not run, and if a motor works at all with the spark plugs screwed in too far, as shown in Fig. 26, it will be in the nature of an accident; whereas, if the spark plug is only part way in, as shown in Fig. 27, nothing very good by way of performance can be expected. One of the first things that a buyer of an automobile should do is to look at the spark plugs and see if they are a good fit in the cylinders, but if this formality is overlooked until the automobile changes hands, it is the plain duty of the owner of the car to make the best of a bad bargain, which is a matter of searching around until he can locate long or short types of spark plugs that will fit in the manner as shown in Fig. 23. There is strong ground in this presentation in favor of adhering to a standard, and certainly the purchaser will be justified in paying more for an automobile that is designed along standard lines than he should be willing to pay for an automobile of the other kind.

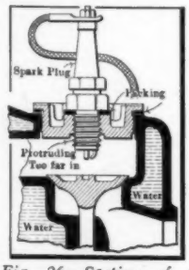


Fig. 26—Section of a cylinder through the valve, showing the spark plug in the cap screwed in too far.

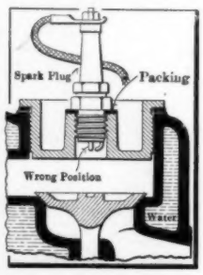


Fig. 27—Section of a cylinder through the valve, showing the spark plug in the cap not screwed in far enough

REAR WHEELS COME OFF BETIMES — Certain types of construction of live rear axles have been known to give trouble, and on a few occasions the wheels have departed from the shaft unceremoniously. This is not a nice thing to contemplate. For the benefit of those who are in a position to appreciate the delicacy of the situation, who, also, have been unable to devise a plan of overcoming the difficulty, it is the intent here to canvass the situation, and by illustration show how the wheels may be brought within the zone of definite control. The idea that has earned such a poor reputation is depicted in Fig. 28, which is a section through the hub of the wheel outside of the line of the spokes and the outer flange that binds them into place. The shaft is a parallel fit in the hub and it is prevented from turning independent of the wheel by means of a key, as shown. But since the wheel is merely placed on the shaft with a parallel fit, even if it is a good hand fit, there is nothing to prevent it from floating off, and, for this purpose, a taper pin is passed through a taper hole which is made in the hub (under the hub cap), into which the taper pin is driven with a showing of force. In the course of a little time the key gives a little under the work and the taper pin then bends to the pressure that is brought upon it, after which the key gives a little more, and finally the taper pin is sheared off at points near its two extremities, just at the shear point. All sorts of materials have been suggested for the pin in work of this sort, but up to the present time nothing has been found that will stand up under the shearing strains.

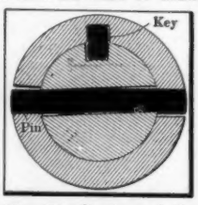


Fig. 28—Section of the hub of a wheel which is held on the shaft by a taper pin with a key to take torsion

There are several possible ways of getting around the shearing trouble. Fig. 29 shows a very simple way of relieving the situation. In this example the shaft is flattened at the hole on each side where the taper pin comes through, it being the purpose to prevent the shearing action, substituting a bending moment instead. It cannot be said that this is an ideal construction, but it is a considerably better plan than the one that found so much favor among the class of designers who practiced this art. Fig. 30 present a plan that entered the fertile brain of one novice who was unable to keep the wheels on the shaft, and it may not be out of place to relate that this plan worked quite well. As will be seen, the shaft was reduced in diameter at the extremity and threaded, and a cap was made with two threading diameters, one of which screwed over the hub in the regular way and the smaller diameter thread fitted the thread of the shaft. This method of holding the wheel on, while it depended upon the cap staying on, is free from the objectionable shearing action that has caused so much trouble in the past, and the work was thrown upon the key where it belongs.

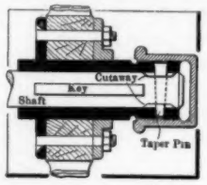


Fig. 29—Section of the hub of a wheel keyed on and prevented from drifting off by a taper pin in the bending relation

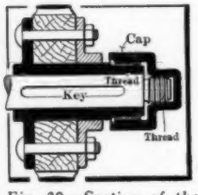


Fig. 30—Section of the hub of a wheel keyed on a shaft using a double threaded cap to keep the hub on the shaft

Perhaps Fig. 31 offers the greatest measure of relief, all things considered, especially in view of the fact that in the working of the plan it is not necessary to replace the shafts or to make new hub caps. The execution of this plan requires that a hole be drilled in the end of the shaft, half in the hub of the wheel, and after the hole is drilled it must be threaded for a capscrew. The capscrew may be ⅜ of an inch in diameter and the thread should be about 18 to the inch. When the capscrew is put into place it will keep the wheel from backing off of the shaft, and since the capscrew is half in the shaft and the rest in the hub, it relieves the key of some of its work, thus serving a double purpose. This idea in machine construction has been used in quite a number of difficult situations and rarely ever has it been known to fail. It would not be a good idea to abandon the key on the ground that it will be unnecessary if the capscrew serves as a key as well as for keeping the wheel from backing off of the shaft. In fitting the key, remembering that it is a better member for torsion work than a round member in view of its flat bearing faces, care must be taken to scrape it to slight taper and to hand-fit it so that it will have to be driven home.

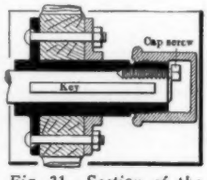


Fig. 31—Section of the hub of a wheel keyed on a shaft with a cap screw in the half-and-half relation to prevent floating

VALVES WARP IF THE MUSHROOM IS WRONGLY SHAPED—It is not difficult to keep the inlet valves tight due to the fact that they are maintained at a relatively even temperature on account of the cooling effect of the incoming mixture, it being the case that this mixture is more or less a "refrigerant" due to the process of evaporation of liquid gasoline that is always going on in the region of the inlet valve, this being the point in the system where the entrained liquid strikes the atmosphere of higher temperature. The exhaust valve is unfavorably situated, since it never contacts with the refrigerating mixture, and it is in the path of the exhaust products of combustion which are always above a red heat, and when motors are poorly managed, the tem-

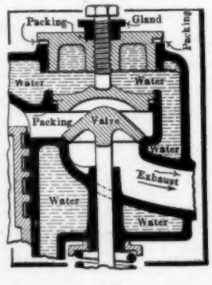


Fig. 32—Section of a motor cylinder through the valve and cap, showing a water jacketing scheme that works and a mushroom of special form

perature of the exhaust products is very high indeed. Fig. 32 shows the shape of an exhaust valve that might be free from troubles due to heating. Moreover, with the water jacket extending between the inner and outer cover of the exhaust valve opening, considering the near approach of the valve to the water-cooled inner cover in juxtaposition, a certain amount of cooling effect is a reasonable expectation. It has always been a source of regret among designers of automobiles that the piston head and the valves do not lend themselves to water-cooling. The next best course is to provide a water jacket adjacent to every flame-swept surface, making sure that the thicknesses of the walls around the valve seat shall not exceed the normal wall thickness, and that water will circulate vigorously over the exterior surfaces adjacent to the seat of the valve. In the operation of an automobile the driver can do much to maintain cool relations if the spark is advanced co-relating with the speed, for then the temperature of the exhaust products of combustion will be relatively low, and as a secondary advantage attending this plan of operation the motor will deliver a better measure of power, and, incidentally, the thermal efficiency of performance will be on an improved basis.

GASOLINE MUST BE BOILED BEFORE IT WILL BURN—There are three states of aggregation for media. Water is such a well-known compound that we are not surprised that it will freeze into ice or boil into steam, thus affording an example of the three states of aggregation, i. e., solid, liquid and gas. There are some substances in the catalogue of media that have not as yet been resolved into the three states above referred to, and gasoline, for that matter, does not reside under normal conditions in the solid state. It is known to the automobilist as a liquid or a gas, but in order to change the gasoline from its normal liquid form to its unusual gas state heat must be supplied to the liquid to offset the latent heat of evaporation; in other words, the gasoline must be reduced to a state of ebullition, and of this state Webster says: "Ebullition—A boiling or bubbling of a liquid; the motion produced in a liquid by its rapid conversion into vapor."

In order to avoid fuel trouble the automobilist must be brought to a proper understanding of the necessity of heating the gasoline in order that it will vaporize, but it is a mistake to apply this heat to the liquid before it streams out of the nozzle of the carbureter. Remembering that the amount of gasoline in liquid form that must be delivered through the nozzle of the carbureter to the stream of incoming air must be in a fixed ratio for the best result, considering the fact that if the nozzle is a fixed size it will be apparent that the gasoline must be delivered through the nozzle at a fixed pressure, and the quantity of gasoline that will flow through a given size orifice with a given head, will only be constant if the temperature of the liquid is maintained at a fixed level. The reason for this lies in the property of a liquid, whereby its viscosity changes with the temperature. The viscosity changes that will be noticed are not the same for all liquids. Considering gasoline, these changes are substantially as follows:

Temp. °F..	50	59	68	77	86	95
Weight in unit time..	1	1.073	1.145	1.212	1.27	1.335

These figures are for the quality of gasoline known as hexane, the formula of which is $C_6 H_{14}$ With automobile gasoline, which is made up of a plurality of the fractions of the distilling process of a higher specific gravity, departure from the above values will be more marked, and if the gasoline is heated before it passes through the nozzle of the carbureter the evidence of an unbalanced condition will be in greater presence. Fig. 33 shows in cross section the modified Venturi tube with the nozzle in the concentric relation with the water-jacketed member, and the apex of the pair of truncated cones out of which the Venturi tube is formed coinciding with the nozzle extremity of the gasoline passageway. The hot water that is circulated in the jacket around the Venturi tube will impart heat to the stream of gasoline as it sprays out of the nozzle and is entrained in the incoming air, rather than to the liquid gasoline within the liquid system, due to the fact that cold air comes up around the piping and the heat that is delivered by the water in the jacket has the shortest distance to travel to get into the liquid gasoline as it sprays out of the nozzle, as the construction shows. The gasoline is sucked out of the nozzle by the depression that is formed in consequence of the displacement of the piston in the cylinder of the motor, considering the obstruction formed by the butterfly valve at the upper end of the Venturi tube, thus fixing the depression in the region of the nozzle. Since the pressure on the gasoline as it resides in the float bowl and flows in the piping to the nozzle is back of the atmosphere, which is 14.7 pounds per square inch, the depression referred to is in consequence of the displacement of air in the depression chamber and the difference between this displacement and the atmospheric pressure represents the suction pressure by means of which the gasoline streams out of the nozzle.

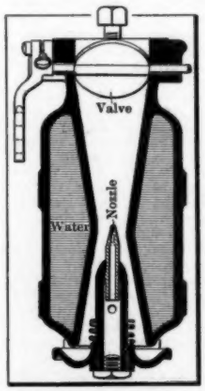


Fig. 33—Section of a carbureter of the Venturi tube type, showing a scheme of hot water jacketing

This principle of design and construction of carbureters obtains in the various makes, subject to modifications, and in many examples of carbureters in actual practice, the heat required for the boiling of the gasoline is furnished by heating the air before it reaches the nozzle rather than by transferring heat from the water in the jacket to the cold air in the region of the nozzle. It is immaterial how the heat is transferred to the liquid gasoline to make it vaporize as long as the latent heat of evaporation is satisfied, and this is a matter of supplying about 210.5 British thermal units of heat per pound of gasoline.

ADJUSTING THE CARBURETER IS A SIMPLE PROCESS—Every time a motor quits running, if the owner of the car is relatively inexperienced, he lifts the bonnet of the motor and espying the carbureter takes a few turns on every adjusting screw that he can find without counting the consequences. In nine cases out of ten the trouble is not in the carbureter at all. When confronted with a refusal on the part of the motor to go about its business, the operator should first look into the gasoline tank and see if there is any more liquid left. He should then observe whether or not the valves that permit the liquid to flow to the carbureter are open. If the carbureter primes, showing ample evidence of a good supply of gasoline, the next question is, does the manifold leak air at a point between the carbureter and the cylinders? If so, the leaks must be stopped; this may be accomplished by tightening up on the holding bolts or renewing the packing if necessary, unless, perchance, there is a blow-hole in the manifold casting, or some other flaw that is at the bottom of the leak. At all events, the manifold must be tight, and to stop up a flaw is a mere matter of whittling a stick and driving it into the hole so that it will stay there, pending the time when a more artistic repair can be made. If the trouble still persists, the ignition system should be given a measure of attention; find out if the battery is in strength to serve for its purpose; examine the wiring for loose joints; inspect the timer and see if the brushes are in good bearing, and so such other things as are more likely to be at the seat of the trouble than the carbureter. But if the carbureter must be attacked, arrive at a good understanding of its functions and how they are performed before making the adjustments. Referring to Fig. 34 of a section of a carbureter, which is presented merely to help the understanding, remembering that it is not a regular carbureter of the market, it will be observed that the gasoline flows into the float-bowl from the top in this case (it might come in at the bottom in other examples) and the needle serves as the obstruction, preventing the flow of the gasoline when the quantity of the liquid present in the bowl is sufficient to buoy up the float and lift the needle against its seat. To prime the carbureter it is necessary to press down on the primer, the stem of which bears against the float, overcoming its buoyancy, causing it to sink, thus permitting the needle to back away from its seat and allow additional gasoline to enter so that when the priming operation is completed the gasoline will flow out of the nozzle, due to the raising of the level of the gasoline on account of the difference in the head between the liquid in the float-bowl and the orifice of the nozzle. If the gasoline will not flow from the float-bowl to the nozzle, it must be on account of an accumulation of foreign matter in the passageways, in which event it will be necessary to back out the screws S1 and S2, and with a piece of wire clean out the passageway, during which operation the cocks C1 and C2 may be opened, thus permitting the gasoline charged with foreign matter to depart. The means at hand for cleaning out the passageways of carbureters are not always in the same place, but it will be easy enough to find them in well contrived carbureters, and the point here is to remember that gasoline carries paraffine and sediment on occasions, which adhere to the walls of the passageways and stop off the flow of the liquid. Tracing gasoline to the nozzle as the result of priming assures that the supply of the liquid will be in sufficient presence if the nozzle is not stopped up. The best ways to ascertain as to the condition of the nozzle is to open the drain cock in line with the same and shove a piece of wire through the nozzle for the purpose of cleaning it out. Having thus completed the exploration for the purpose of freeing the passageways for the liquid, it will be timely to adjust the relation of the gasoline that flows out of the nozzle to the air that is sucked in by displacement of the piston.

In adjusting the relation of air to gasoline the first thing to do is to either increase the flow of gasoline by adjusting the needle valve in the nozzle, if the carbureter is of the type that affords one, so that the amount of liquid that will pass into the incoming air will be sufficient to make the motor run (without load) at its lowest possible speed, and the slower that the motor can be made to turn over the better will be the result. Having completed the low speed adjustment, the next operation is to speed the motor up until it shows confusion, which will be due to an over-rich mixture on account of the tendency on the part of the gasoline to increase its rate of flow in a greater ratio than the rate of flow of air, and the second adjustment must be for the purpose of diluting the mixture, which may be done by admitting more air through the auxiliary valve,

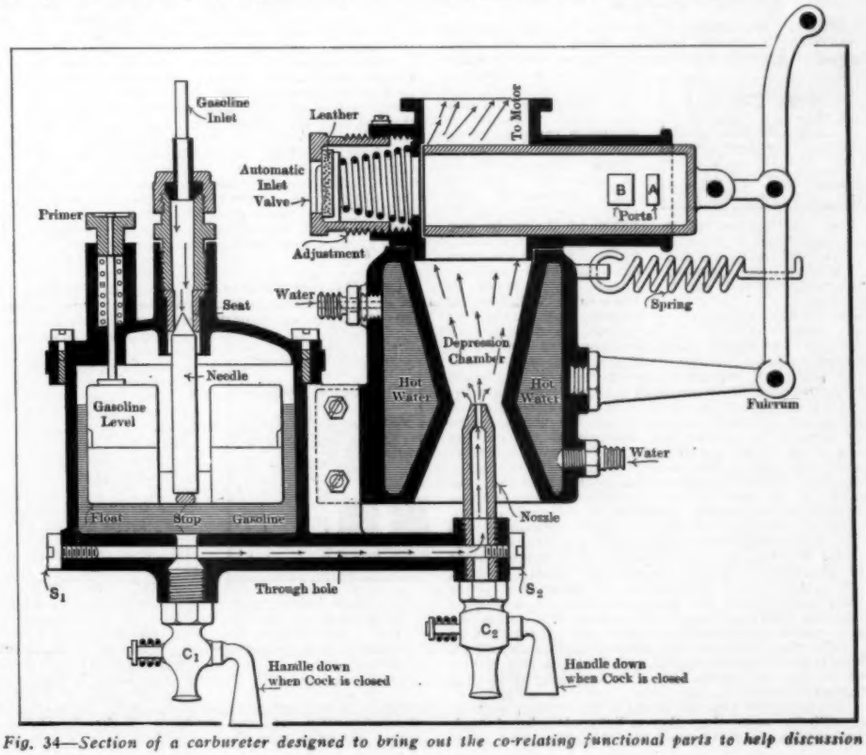


Fig. 34—Section of a carbureter designed to bring out the co-relating functional parts to help discussion

which, in this example, was in the form of a sleeve valve, which is held in the closed position by a spring, and is opened by means of a lever, admitting the auxiliary air through ports A and B that are uncovered as the sleeve is pulled out against the force of the spring. The motor should be made to run at its highest attainable speed by adding air to the auxiliary valve, and when this operation is accomplished it may be said that the motor will run at its lowest possible speed when the auxiliary valve is closed, and it may be made to go at its highest possible speed when the auxiliary air valve is open. For the rest it is a matter of adjusting the automatic air valve, if one is supplied on the carbureter, to give the best power performance at intermediate speeds. Some carbureters work perfectly well without an auxiliary valve, giving good result, due to the adjustments for high and low speed, but other carbureters are designed, including an automatic valve, which supplements the effort of the auxiliary air valve, and the operator, by making a few trials under load conditions, will soon be able to adjust the auxiliary air valve for the best power result. Substantially all float-feed carbureters may be handled by a man of almost no skill, if he will remember that the motor must be made to go at its lowest possible speed with the auxiliary air valve closed, and it must be made to rotate at its highest attainable speed when the auxiliary air valve is open the right amount.

POORLY INSTALLED GASOLINE PIPING IS A HAZARD—If the gasoline piping, which is made of copper, is not annealed, it will be too irresponsible to employ in this exacting service. If the diameter of the pipe is too restricted jelly and foreign matter that accumulates in gasoline will soon stop up the passageway and the motor will quit running. If the piping is installed, using short lengths for the purpose, there will be a lot of unnecessary joints, and the chances for trouble from this source will be unduly augmented. But even if the piping is of a good size, properly annealed, and unbroken lengths are employed in the leads, the joints may be bad, due to the fact that the workman who makes the installation will be lacking in skill sufficient to make him appreciate the importance of a "fair" lead. Referring to Fig. 35 a fair lead is shown at C, requiring the gasoline pipe to be bent so that the two parts of the joint will be in juxtaposition to each other, but if the pipe is not bent the condition will obtain as shown at B, excepting when the workman gives the pipe a yank and pulls it over to a point opposite the mating member of the joint as shown at A.

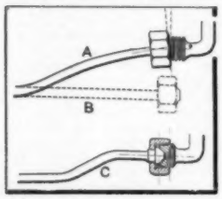


Fig. 35—In the installation of gasoline piping, showing the right and wrong way to make the joints

PROPER MANAGEMENT OF THE WATER COOLING SYSTEM—In actual practice there are two divisions of the water cooling system as used to maintain a proper temperature of the motor, and the difference between the two methods in vogue is represented by the substitution of a water pump, as shown in Fig. 36, for the thermo-syphon (so called) method of circulation as shown in Fig. 37. Some of the points to be observed are common to both systems. Clean water must be put into the cooling system, due to the fact that sediment, if it is permitted to collect, will be the most likely to accumulate over the water-swept surfaces of the domes of the cylinders at the point of highest temperature, and the scale that forms on these surfaces will be responsible for spheroidal action, in which event the circulation of the water will be to no purpose. The second point of importance in the maintenance of the cooling system is to so operate the motor that the water will not boil. This may be accomplished in a properly designed automobile by avoiding the running of the motor on a retarded spark, making sure that the spark is advanced all that is possible, considering the good delivery of power, and the motor should be kept running at the relatively high speeds, to do which is a mere matter of sliding the gears when it is desired to run the automobile at a slow rate of speed. It is on hill-climbing and on long stretches of bad road that the gears will have to be shifted to make the automobile go slow, but under no circumstances should the operator use the motor to deliver a heavy load, regulating the speed of the automobile by slowing the motor down rather than by sliding the gears.

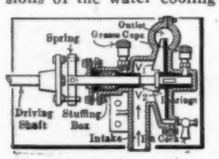


Fig. 36—Section of a centrifugal pump, showing a safety dog drive to prevent damage if the water freezes

Referring to Fig. 37 of a thermo-syphon system, it will be seen that the radiator is placed high up relative to the top of the cylinders, and when the system is filled with water the cylinders are submerged. The water runs from the bottom of the radiator into the lower portion of the water jacket through the connection *e*, and the hot water passes through the piping above the domes of the cylinders, entering the radiator at the point *a*. In this particular radiator, which is of the McCord type, as used on Regal automobiles, any steam that is made passes up to the space *b* at the top of the radiator, and the water passes down to the bottom of the radiator. It is believed that the vigorousness of the circulation of water in the so-called thermo-syphon systems is due to the generation of steam on the dome surfaces of the cylinders, and when this steam rushes in the direction of the radiator it forces the water along with it so that in all fairness the thermo-syphon circulation is on a par with systems employing a circulating pump, it being the case that the slugs of steam that come away at timed intervals serve the same purpose as the veins of the centrifugal pump that generator pressure in the column of water, and in the equalization of this pressure the water is impelled through the piping system, thus accounting for the circulation. In the particular radiator shown in Fig. 37 there is a vertical division of the tubes whereby the steam and water that go to the space above flow down through the frontal compartment, and the water that is free from steam falls by gravity from the point *a* to the space at the bottom of the radiator through the back compartment. In this fashion the steam, which carries a large part of the heat units, is more readily condensed into water, because it is brought into contact with the most cooled part of the radiator at the front, which is struck by the cold air as the automobile moves forward in the atmosphere. There is a point here that is not usually given consideration. The number of heat units in a pound of water that is heated 100 degrees Fahrenheit is approximately 100 British thermal units, but when a pound of steam is made the latent heat of evaporation, which is 965.7 British thermal units, must be added to the 100 units that are taken up in the heating of the water. It will be seen by this comparison that a vast amount of heat may be transported from the domes of the cylinders to the water jacket in the form of steam. All that remains is to condense this steam in the radiator, which must be suitably designed for the purpose, in view of the greater difficulty involved in condensing steam as compared with cooling water.

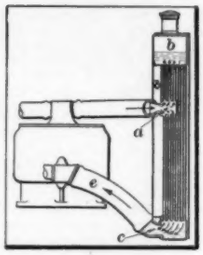


Fig. 37—Section of a radiator as used in the thermo-syphon system, showing the course of the water and the disposal of steam

In the use of a water pump it is customary to employ a centrifugal type, as shown in Fig. 36, and from the operator's point of view there is little to be said, excepting that the pump should be drained out in the Winter time, which is a mere matter of opening the draincock at the lowest point in the system, but unless this operation is attended to the pump will stick, due to the freezing of the water, and when the motor is started the next time the shaft will be twisted off unless a safety joint is employed, one of which is shown in Fig. 36, comprising a flat spring fastened at its center to the end of the pump shaft, engaging driving dogs at its extremities, the dogs being secured to a flange-like termination of the driving shaft. If the pump sticks, the flat spring deforms, slipping off the dogs and saving the pump from destruction.

LEAD BATTERY TERMINALS CANNOT BE SOLDERED—In electric vehicle work where the battery receives the attention of experts, when it is desired to assemble the elements, the straps are burned to the necks in the manner as shown in Fig. 38. In this work, the heat of the hydrogen flame is so high that the needle-like flame as it contacts with the metal melts the same locally, and if the point of the flame is directed at the edges to be joined, the metal of the neck of the plate and the metal of the plate itself will run together and form a homogeneous connection. It is important that the joints be made by "burning," as here shown, due to the fact that solder being an alloy of lead and tin, frequently carrying impurities, will disintegrate electrolytically, and the products of the dissolving alloy will drop into the electrolyte in the cell of the battery and do damage. When the plates are burned in the manner suggested it is lead to lead, and the ill effect of the elements of alloys are thwarted. The hydrogen flame is produced professionally through the use of a hydrogen generator, as shown in Fig. 39, in which zinc is put in the bottom of the generator, and diluted sulphuric acid is placed in the vessel above. An automatic valve prevents the flow of the diluted sulphuric acid above, excepting at a certain rate, which is just sufficient to produce the amount of hydrogen gas required at the burner. The gas is generated, due to the dissolving of the zinc, by the diluted sulphuric acid, and the pressure of the gas as it rises in the chamber B through the tube T regulates the flow of the acid. The amount of the pressure depends upon the head, and this is regulated by the height of the stored diluted sulphuric acid above the zinc in the bottom of the container. Referring now to ignition batteries as they are placed in the keep of the owners of automobiles, if the connections become bad, or if it is desired to clean the batteries and then reassemble them, the temptation to use a soldering iron is very great, but the work must not be done in this way, for the reason as before stated, and on this account if joints must be made it will be desirable to send the battery to a repair shop where a hydrogen flame is available for the purpose as here described.

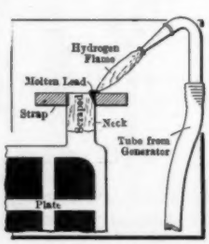


Fig. 38—A battery plate with a cross bar being burned on by means of a hydrogen flame

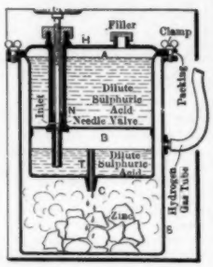


Fig. 39—Section of a hydrogen generator as used for producing hydrogen for burning batteries

MAKING A FLYWHEEL IS A DESIGNER'S PROBLEM—When the amateur gets a little experience by running one or more automobiles for a time his ambition grows, and he begins to see wherein he can beat the designer at his own game. There is no gainsaying the fact that road experience is worth something to the professional designer, but this is not to say that the man who gets road experience will be a better hand than the designer in laying out the car. Space is not available to tell of all the mistakes that road experience would put into a new automobile if it had a chance, but one or two of the apparently simple situations will suffice to illustrate the point to be made. Referring to Fig. 40, of a section of a flywheel, it will be seen that the same is flanged to the crankshaft, and that most of the weight is accumulated in the rim; moreover, the rim is tapered to take the cone clutch, and the idea looks so simple that the man with road experience would get the impression that all he has to do is to tell a workman to turn up a pattern to some diameter that he might take from an automobile already made. The pattern, when it is sent to the foundry, will be declined as being wrong for the purpose, on the ground that the flange of the flywheel is not dished, it being the case that internal strains will be induced in the casting if the flange is at right angles to the axis of rotation, whereas by dishing the flange it will give in response to the internal strains, and they will be relieved accordingly. The strength of cast iron from the designer's point of view is 18,000 pounds per square inch, but if the design is such that internal strains abound up to, say, 10,000 pounds per square inch, the remaining strength in the structure, from the designer's point of view again, will be 8,000 pounds per square inch, and this is in the face of the fact that a foundry man can pour a test bar that will show a strength of 35,000 pounds per square inch. One more point and the subject will be dropped. The peripheral velocity of a flywheel of cast iron should not exceed a rate of travel of a mile per minute. Some motors run at 2,000 revolutions per minute, whereas other motors operate at perhaps one-half of this speed. If the novice takes the diameter of the flywheel of a slow-speed motor and he then designs a high-speed motor, using this diameter, he will get into trouble. When the motor is speeded up the flywheel will disrupt. The reason for this lies in the fact that the extreme fiber strain is as the velocity squared, which is another way for saying that a flywheel of a fixed diameter will have induced in its extreme fiber four times the strain

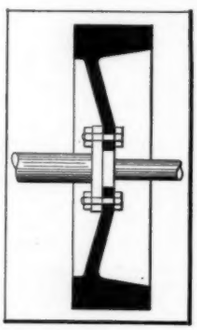


Fig. 40—Section of a flywheel flanged to a crankshaft, showing the dishing of the spider for the sake of safety

of 1,000 revolutions per minute if the speed is increased to 2,000 revolutions per minute, and so on. From what has been said it would appear that the designer's problem is not to be disposed of by the man who merely gets road experience.

SUBSTITUTING BRASS CASTINGS FOR PROPER MATERIAL IS AN INFERIOR UNDERTAKING—When men of no experience decide that they can build automobiles better than those who burn the midnight oil they engage a capable draftsman, perhaps, and make a nice-looking set of drawings, all of which takes time, and being unaccustomed to taking twelve solid months in a mere designing undertaking, they get in a hurry ultimately, and despite the fact that the draftsman classifies suitable grades of steel for the important parts, his judgment is overruled and brass castings are procured, because they may be had quickly. Referring to Fig. 41, of a differential brake-drum, the section shows that the drum is flanged to the driving part, and the face of the drum is of some width, with a flange at the edge opposite the spider. The idea in flanging this edge is to prevent the drum from spinning into a cone, which it will do under the pressure of the shoes or the band if the drum is made of brass, or if the designer neglects to place a flange in support of the outer edge. In this design the spider is so shaped that oil when it sneaks out of the bearing and creeps up on the spider will be picked up by the slinger (so called) and cast off, thus preventing it from smearing over the face of the drum. Oil on the drum-face lowers the coefficient of friction of the facing fabric, prevents the dissipation of heat and causes failure. By properly designing the drum the face will be kept free from escaping oil, and the facing fabric on the shoes or the band will then do its proper work and last for a long time.

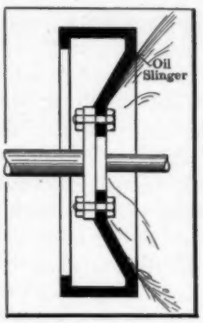


Fig. 41—Section of a differential brake drum of the flanged-over type so designed as to sling oil clear of the face.

NEW SCHEME OF VALVE THAT MIGHT WORK—The vast amount of work that is being done on sleeve types of valves, not forgetting a variety of piston valves that are peeking above the horizon, suggests that there must be quite a number of poppet types of valves that are not working as well as the owners thereof could wish. The difficulty with the troublesome types of poppet valves may be traced to three causes, (a) lack of uniformity of the cooling water on the exterior surface in juxtaposition to the seat; (b) the use of inferior material in the mushroom and the stem of the valve; and (c) the shape of the valve. Remembering that valves of this type in automobile work cannot be water-cooled on account of the high speed; remembering also that the exhaust valve is swept by highly-heated "fluid," provision must be made to get rid of this heat; otherwise it will pile up in the mass of the mushroom, and the difference in temperature between the mushroom and the stem will cause the latter to curl, after which the valve will defeat grinding to tightness. The inverted cone-shaped mushroom, as presented in Fig. 42, has the virtue of being of great strength for weight; it offers the further advantage that the portion that seats, being at the lip of the bell, if it expands, will grow tighter, and attention is specifically called to the fact that the body of the metal is in the direction of the apex of the cone, and the heat will be prevented from sweeping over the surface by the gas that will reside in the cavity, the latter being an insulator, comparing it with metal.

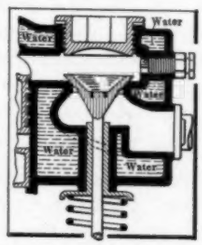


Fig. 42—Section of a cylinder through the valve and cap, showing a bell-shaped mushroom bearing on a level face

MUFFLERS CAUSE BACK PRESSURE.—Even in a new motor of a good design, if the muffler maintains silence, it is more than likely that the muffler will induce back pressure. It will be understood that each pound of back pressure takes an equal pressure from the mean effective pressure of the motor. If a motor has been running for some time and the muffler has been allowed to accumulate a quantity of carbon, silicon and other substances of combustion, the amount of the back pressure that will then be experienced may be enough to detract materially from the original power of the motor. Just what this back pressure problem amounts to is a matter that can best be appreciated by examining tests that have been made on new motors under the best of conditions for the purpose of determining the amount of the same. In this example the motor was of the six-cylinder type, with a bore of 4½ inches and a stroke of 5½ inches. Two runs were made, one with the muffler in place and the second with the muffler removed. Note the difference in power at the various speeds with and without the muffler:

First Run With the Muffler in Place.

R.P.M.	Brake Pull.	HP.	HG. Inches.	Lbs. per Sq. In. Back Pressure.
400	71	16.2	1	.98
500	71	20.2	1¼	1.72
600	75	25.7	2¼	2.2
700	72	29.6	2½	2.45
800	69	31.6	3	2.94
900	65	33.4	3½	3.43
1000	63	36	4	3.92
1100	57	36.5	4¼	4.15
1200	54	37	5	4.9
1300	52	35.6	5½	5.38
1400	50	40	6	5.88
1500	43	37	6½	6.36

Second Run With the Muffler Removed.

Muffler taken off. Exhaust through 15 feet 3 inch pipe. No other change. Maximum back pressure was .5 at 1500 R.P.M.

R.P.M.	Brake Rod.	H.P.
400	80	18.3
500	80	22.9
600	71	24.3
700	71	28.4
800	71	32.4
900	70	36.
1000	70	40.
1100	69	43.4
1200	68½	47.
1300	64	47.5
1400	64	51.2
1500	59	50.6

BACK PRESSURE MAY BE DUE TO OTHER CAUSES.—A further test of the motor as above referred to for the purpose of noting the effect of ignition on the delivery of power, went to show that suspecting the muffler may be wrong, the ignition system may be the offending member. If the ignition system is incapable of doing its proper work, the condition of scavenging may be poor; the failure to ignite the mixture at the right time presents two evils, i.e., the energy in the fuel will not be released and the scavenging relation will be at the bottom of an additional crop of trouble.

Run Made With the Magneto Properly Adjusted.

Speed.	Brake.	Manometer.	Back Pressure.	H.P.
400	74	1.24	.61	16.9
500	77	2.00	.98	22.0
600	72	3.	1.47	23.6
700	70	4.4	2.15	28.
800	60	4.4	2.15	27.4
900	57	6.	2.94	29.4
1000	55	7.	3.43	31.4
1100	63	8.4	4.1	39.6
1200	60	10.	4.9	41.
1300	54	11.	5.4	40.
1400	50	12.4	6.1	40.
1500	45	14.	6.85	38.

AUTOMOBILE WORK MUST BE ACCURATE—Accuracy, while it is necessary in general machinery, is an absolute requirement in automobiles. The old idea was that accuracy depended upon the skill of the man, and it does to a very considerable extent, when the man takes into account the weakness of the tool and by skill limits output to that which will check with the inherent defect in the tools placed at his disposal.

In the early days of the automobile, when ordinary machine tools were all that could be had, men were paid to limit output, and skill on the part of the men was an absolute necessity, because the limit they placed upon the output was that which would induce a measure of accuracy in view of the inherent weakness of the machine tools.

No wise automobile builder will care to go back to the days when skilled machinists were paid to limit the work in proportion to lack of ability of the tools used. No doubt this is an odd way of putting it, but it is in exact accord with the facts as they existed. Automobile work then reflected excess cost and poor workmanship, taking it as a whole. Makers of automobiles were compelled to exact special and more rigid machine tools for the purpose, and in the absence of regular stock products to be had on this basis it became necessary to go in for special machine tools and they, in all probability, considering the respective shops, were designed with a particular eye to the hardness and tenacity of the metal used in the construction of the automobiles.

Calendar of Coming Events

Catalogue of Future Happenings in the Automobile World That Will Help the Reader Keep His Dates Straight—Shows, Race Meets, Runs, Hill Climbs and Other Events.

RACE MEETS, RUNS, HILL-CLIMBS, ETC.

Date indefinite—Shreveport, La., Track Races.
May—Lancaster, Pa., Three-Day Endurance Run, Lancaster County Auto Trade Association.
May 13—Nazareth, Pa., Track Races, South Jersey Motor Club.
May 13-14—Oakland, Cal., 24-Hour Race, Oakland Motordrome.
May 13-14—Latonia, Ky., Track Meet, Cincinnati Auto Dealers' Association.
May 14—Jacksonville, Fla., Track Races.
May 16-19—Washington, D. C., Four-Leaf Clover Endurance Run, Automobile Club of Washington.
May 22-24—Los Angeles, Cal., Commercial Vehicle Run, Los Angeles *Examiner*.
May 25—Chicago, Ill., Fuel Economy Test, Chicago Motor Club.
May 27-31—Chicago, Ill., Five-Day Tour to Indianapolis, Chicago Automobile Club.
May 29-31—Chicago, Ill., Tour to Indianapolis, Chicago Motor Club.
May 30—Denver, Col., Track Races, Denver Motor Club.
May 30—St. Louis, Mo., Reliability Run, Missouri State Automobile Association.
May 30—Indianapolis, Ind., Five-Hundred-Mile International Sweepstakes, Motor Speedway.
June 7—New York City, Orphans' Day.
June 8—Algonquin Hill Climb, Chicago Motor Club.
June 10-11—Chicago, Ill. (Hawthorne), Track Races.
June 15, 16, 17—Dayton, O., Midsummer Meeting Society of Automobile Engineers.
June 15-20—Endurance Run, Cañon City, Col., to Hutchison, Kan.
June 16-20—Des Moines, Iowa, Annual Tour, Hyperion Field and Motor Club.
June 17—Portland, Me., Hill Climb, Maine Automobile Association.
June 19-25—Glidden Tour, Washington, D. C., to Ottawa, Canada.
July 1-3—Motor Contest Association's Catskill Run.
July 4—Detroit, Annual Track Meet, Wolverine Automobile Club.
July 17-19—Cleveland, O., Three-Day Reliability Run of the *Cleveland News*.
July 17-22—Wisconsin Reliability Run, Wisconsin State Automobile Association.
July—Indianapolis, Indiana Four-State Tour, Indianapolis Auto Trade Association.
Aug. 25-26—Elgin, Ill., National Stock Chassis Road Race, Chicago Motor Club.
Oct. 9-13—Chicago, Ill., Thousand-Mile Reliability Run, Chicago Motor Club.

FOREIGN FIXTURES.

May 1-15—Turin, Italy, Automobile Salon.
May 14—Barcelona, Spain, Catalona Cup Road Race.
May 21—Limonest, France, Annual Hill-Climb.
May 21—Ries, Austria, Hill-Climb.
May 25—Meuse Hill-Climb, Belgium.
May 25—Le Mans, France, Touring Car Kilometer Speed Trials.
May 28—Le Mans, France, Hill-Climb for Touring Cars.
May 28—Start of Touring Car Reliability Trials in Germany.
June 1—Bucharest, Roumania, Speed Trials.
June 4—Trieste, Austria, Hill-Climb.
June 18—Boulogne, France, Voiturette and Light-Car Road Races.
June 25—Sarthe Circuit, France, Grand Prix of Automobile Club.
June 25-July 2—International Reliability Tour, Danish Automobile Club.
July 5 (to 20)—Start of the Prince Henry Tour from Hamburg, Germany.
July 9—Susa-Mont Cenis Hill-Climb, Italy.
July 13-20—Ostend, Belgium, Speed Trials.
July 21-24—Boulogne-sur-Mer, Race Meet.
Aug. 6—Mont Ventoux, France, Hill Climb.
Sept. 2-11—Roubaix, France, Agricultural Motor Vehicle Show.
Sept. 9—Bologna, Italy, Grand Prix of Italy.
Sept. 10-20—Hungarian Small-Car Trials.

THE AUTOMOBILE

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KEEPING an automobile is at an excess cost unless an adequate return is realized upon the investment. Against returns the items of cost taper down from the maximum beginning with the tires, fuel, lubricating oil, keeping up the body finish and general maintenance, not forgetting the chauffeur. That the automobile is now a paying proposition has been proven in a thousand ways, and it only remains to work in specialized channels in order to improve the investment. Naturally, the investigator would put his time in on the part that promises the most for the effort; in other words, the tires. In approaching the tire problem it is no longer of great value to take tires as they are furnished in response to the maker's demand, and to put them on automobiles without considering the characteristics of the particular makes of cars. It is being shown in THE AUTOMOBILE this week that tire improvement is a deep-seated possibility, and granting that there is excellent promise of satisfactory return for effort, the fact remains that future gains must be reckoned by men who do not reside in a mediocre habitation.

* * *

TAKING worn-out automobiles in part payment for new cars is a practice which promises to guide the builders of automobiles through a dense forest of difficulty, reacting unfavorably in course of time upon the very purchasers who so persistently represent that the cars that they are through with are as good as money. In the meantime, at the plants of the makers, nothing but money will suffice to pay bills, and as for the dealers who represent these makers, their profits go for rent, fuel, lighting, salesmanship, demonstrations, and in the extra effort demanded in the getting rid of the worn-out cars which they seem to be compelled to take in part payment for the new product. The second-hand automobile in the behind-the-scenes part of the automobile business. In other arts, this part of the business is controlled and second-hand machines are handled in such a way that they do not interfere with the sale of new product, nor are they permitted to depress the trade by their unsightly presence. The great main question is to devise a plan which will prevent second-hand cars from becoming a drug on the market, and some of its phases are presented in an article on the subject in THE AUTOMOBILE of this week.

* * *

NOTHING can be plainer than the fact that the steering equipment of automobiles should receive the most careful attention at the hands of designers, not only on account of the danger that lurks in the vicinity of a running car if its steering gear is of inferior workmanship, but in view of the fact that in turning around a corner the tires are worn out, unless the steering wheels are canted so that they will describe the arc of a circle whose radius has a common axis. The cut-and-dry method that seems to be so popular in the haunts of designers is notoriously inaccurate, and the steering mechanisms that are built by rule-of-thumb are at an enormous cost in tire bills in the course of time. It is an intricate undertaking to lay out a steering gear so that the two front wheels will describe a common arc, but it has to be done, and the treatment that is given this subject in THE AUTOMOBILE goes to prove that the only missing link between success and the steering gear is in the nature of a misunderstanding of the possibilities on the part of those whose duty it is to harmonize the contending factors.

* * *

HISTORY, as it relates to aluminum, is an intensely interesting study, and the upward trend of this marvelous substance, from the time when it existed in the laboratory as a curiosity to its common use in automobile work, pays tribute to the ingenuity of the men who are responsible for its existence at a marketable figure. Aluminum is the lightest available metal for motor cases and like parts, but its availability depends entirely upon its strength as compared with cast iron, and the growing need that marks the neck-and-neck progress of demand with supply is likely to prove in the nature of a stumbling block to those who would increase their output at the expense of quality. Of the impurities that abound in aluminum castings, silicon is the most feared, and the question arises as to the expediency of making specifications to include silicon and iron, placing a limit upon the percentage of these two elements that are permissible in the work. Granting that iron, beyond a certain point, is an undesirable content, the fact remains that silicon is to be excluded if the castings are to be reliable, and safety indicates that there is a specific danger in referring to a total impurity including silicon and iron, rather than to specify the limit of silicon on one hand, and of iron on the other.

Grand Circuit Dates Are Announced

Racing High Spots Selected by Contest Board

After the abandonment of the grand circuit racing train idea, the officials who have charge of automobile sporting events met and framed the chief dates and places so that the form of a circuit should be maintained. Under the rules announced the promoters of any of the Grand Circuit events must secure and compensate a regular set of officials. These dates are announced herewith.

OFFICIAL announcement of the dates at which major racing features will be held this year were announced late Wednesday afternoon by the Contest Board. In making the announcement Chairman Butler called attention to the failure through unforseen circumstances of the Racing Train idea.

The National Circuit, as it is termed, is a radical modification of the original plans, but a logical sequence of dates has been preserved.

It is announced that the following dates in the appended list will be available at the places named, but that the promoter who succeeds in getting them must take care of the compensation of the official referee, starter, technical committee and timer.

The list is as follows:

Location.	Event.	Date.
Indianapolis	500-mile track race	May 30
Algonquin	Hill climb	June 8
Milwaukee	Fair Grounds track races	June 13-14
New York	Brighton Beach track races	June 24
Riverhead	Road race	July 1
Port Jefferson	Hill climb	July 4
Worcester	Hill climb	July 4
Philadelphia	Belmont track races	July 29
Detroit	Fair Grounds races	Aug. 12
Elgin	Road race	Aug. 25-26
Indianapolis	Races	Sept. 4
St. Paul	State Fair track races	Sept. 8
Syracuse	State Fair track races	Sept. 16
Lowell, Mass.	Road race	Sept. 23
Philadelphia	Fairmount Park race	Oct. 7
Atlanta	Speedway races	Oct. 19-20-21
Savannah	Light car road race	Nov. 3

The full list of reliability runs and tours, hill climbs and track meetings aside from the Grand Circuit dates will be published in the near future. These include almost 100 events of various kinds and descriptions.

The main difference between them and those of the Grand Circuit is in the fact that the officials who will administer the events need not be those provided for the promoters by the board.

Frank Briscoe Receives Promotion

DETROIT, MICH., May 10—Formal announcement has been made by the United States Motor Company of the delegation to Frank Briscoe of the duties of Supervising Director of its Detroit factories. Mr. Briscoe has been president of the Brush Runabout Company and the Briscoe Manufacturing Company. The change puts him in charge not only of these concerns but the Alden Sampson and Gray Motor plants as well as several associated concerns.

Mr. Briscoe will maintain office headquarters in the new United States Motor building on Woodward avenue in the outer edge of the retail district. Mr. Briscoe is a younger brother of Benjamin Briscoe, president of the United States Motor Company. He is 36 years old, a graduate of the University of Michigan and a manufacturer of experience. He will have more than 4,000 hands employed in the plants of which he is supervisor.

His place as the active manager of the Brush company will be taken by C. S. Briggs, general manager. The output of the Detroit plants of the United States Motor Company is estimated at $7,000,000 annually.

47 Cars Entered in Savannah-Charlotte Run

SAVANNAH, GA., May 6—At six o'clock this afternoon the entry list of the endurance run which is to leave here for Charlotte, N. C., a distance of 392 miles closed with forty-seven entries.

The run will commence on Tuesday morning. The first day's trip will be from Savannah to Augusta. The second from Augusta to Columbia, S. C., and the third day's run from Columbia to Charlotte, N. C.

After the second day's run, which will end in Columbia, a hill climb will take place. The hill is one and a quarter miles long. Only the cars in the run will be allowed to take part.

Those that have entered the run are:

Class A—Stevens-Duryea, F. C. Battey; Stevens-Duryea, Harvey Granger; Stevens-Duryea, A. W. Solomon; Packard, L. Adler; Packard, L. McNeil; Packard, J. A. G. Carson; Packard, M. B. Lane; Lozier, L. H. L. Browne; Acme, W. H. Howard; Olds, S. K. Brown; Packard, Geo. W. Tiedeman; Columbia, Etheridge Motor Co., Columbia, S. C.; Packard, J. T. Shuptrine; Stevens-Duryea, H. F. Kuck.

Class B—Buick, Buick Motor Co.; Elmore, James L. Foster; Overland, G. F. Otto; Buick, E. C. Daniels; Chalmers-Detroit, John W. Alleyn; Maxwell, G. R. Foltz; Cadillac, D. B. Hull; Primo, Bennie Ulmer; Cadillac, J. T. Bowden; Chalmers, F. F. Gaines; Chalmers, S. Mohr; Primo, Motor Co. of Atlanta; Cadillac, G. M. Brinson; White, S. N. Harris; Cadillac, J. C. Schwarz; Buick, C. V. Connerat; Pullman, Charlotte, N. C.

Class C—Cartercar, W. C. Mahoney; E. M. F., S. H. Burroughs; E. M. F., F H Mallard; Oakland, J A Mills; Maxwell, L W Hazzard; Maxwell, —; E. M. F., E. H. Wilson; Maxwell, —; E. M. F., W. C. Thompson; E. M. F., Hazzard & Brockett; Cartercar, Deborde.

Class D—Chalmers, T. A. Bryson; Maxwell, J. C. Overstreet; Flanders, J. J. N. Morel; Maxwell, Greenwood, S. C.; Brush, S. N. Harris.

Jail for Detroit Second Offenders

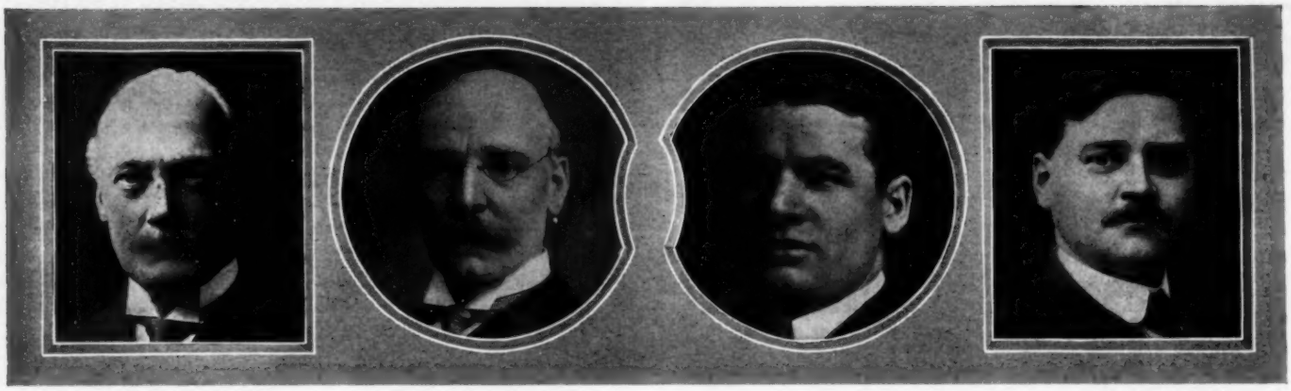
DETROIT, May 8—One of the most drastic laws govering motorists on the code of any American municipality has been favorably recommended to the Detroit Common Council and will probably be passed at the coming session. The measure is known as the Littlefield ordinance and was introduced by Alderman Sherman R. Littlefield. Its most drastic provisions compel motorists to come to a dead stop before crossing any street in which there is an intersecting car line, and impose a similar stop before passing any street car which is standing at a street crossing or trolley station.

One of the new features places a penalty on any motorist who passes to the left of a moving street car.

Jail penalties for second offenses are made mandatory. The ordinance will undoubtedly be tested but it has been approved after careful examination by the corporation counsel.

Glidden Pathfinder Reaches Ottawa

OTTAWA, ONT., May 8.—The Glidden pathfinders reached this city on schedule and, after lavish entertainment by the authorities and the automobile organizations, started home again. The roads were reported to be in fair shape above Burlington, Vt., and in excellent condition south of that place. The officials announced that their report would be ready shortly.



Col. Charles Clifton, President of the Pierce-Arrow Motor Car Co. | Thomas Henderson, Vice-President Winton Motor Carriage Co. | Hugh Chalmers, President of the Chalmers Motor Company | Benjamin Briscoe, President United States Motor Company

A. B. of T. Successfully Launched

Officers Will Be Elected Within Thirty Days

Forty automobile manufacturers, members of the A. L. A. M., met last week to put the finishing touches on the preparation of the Automobile Board of Trade and unanimously indorsed the constitution and by-laws that had been considered before. The final preliminary meeting will be held within a month, when the officers will be selected and a general manager chosen. Horace A. Bonnell was named Acting General Manager of the A. L. A. M.

WITHOUT a flurry the recently organized Automobile Board of Trade, which will succeed to the permanent work for the industry that was commenced by the A. L. A. M., glided forth upon the bosom of the business ocean last week. The new ship was successfully launched, and within the next thirty days will have her engines installed, armor plates bolted in place, and will receive her armament.

At present she is lying in the offing, hitched to a strong cable, while the work of preparing her for her mission is going on apace. The commander and company have not been definitely and completely named so far, but on the best authority the company will be composed at the very first of some fifty members of the A. L. A. M. It is predicted that in the course of a few months about twenty-five concerns that were not numbered with the licensed forces will be enrolled under the banner of the Board of Trade.

The corporation is limited as to its life by the term of twenty-five years and is an organization for mutual benefit, and not for profit. Its objects have been explained in considerable detail in previous issues of THE AUTOMOBILE. They are of broader scope than those of the A. L. A. M., and the organization contains many great possibilities.

The meeting last week was attended by representatives of about forty of the big, typical companies engaged in the manufacture of automobiles, and they were unanimous in endorsing the new project.

As a matter of fact the underlying idea of the Automobile Board of Trade is not new. Several of the progressive members had such an organization as the one that is now developing in mind over a year ago, and proposed to have the preliminary steps taken at that time in anticipation of the expiration by time limitation of the Selden patent. But when the patent was sustained in the Federal District Court by Judge Hough in September, 1909, and it appeared that its validity would probably be upheld in the court of final resort, the plans were allowed to lag. Thus when the United States Circuit Court of Appeals ruled against the A. L. A. M. in January this year, all that was necessary to revive the project was to take up the plans that had been made long before and perfect them for immediate use.

This was done at a series of meetings, the last of which took place last week. The final organization meeting is scheduled to be held early in June, but may be advanced a week or more if conditions shape themselves aright. At this meeting officers will be named, and prior to it an invitation to join the new order and a prospectus describing it will be sent to various prospective members both in and out of the old A. L. A. M.

The committee, which really is the directorate of the new concern, has had charge of the work of organization to date and is composed of the following: Charles C. Hanch, Charles Clifton, Benjamin Briscoe, Hugh Chalmers, S. D. Waldon, Thomas Henderson and S. T. Davis, Jr. Mr. Hanch is treasurer of the Nordyke & Marmon Company, of Indianapolis. He is one of the most virile and aggressive representatives of the industry; a man of intense energy and application. He has been particularly active in the work done so far in framing the new concern.

Colonel Clifton is president of the Pierce-Arrow Motor Car Company and for seven terms led the licensed association as its president. Mr. Briscoe is president of the United States Motor Company and is one of the commanding figures in the industry. Mr. Chalmers is the aggressive and successful head of the Chalmers Motor Company. Mr. Waldon is one of the executives of the Packard company and one of the most advanced thinkers of the industry. Mr. Henderson, an executive and director of the Winton Motor Carriage Company, was for years a leading spirit of the A. L. A. M. directorate. Mr. Davis, of the Locomobile Company of America, is particularly well and favorably known to the trade.

Prior to the meeting of the committee the A. L. A. M. assembled and considered a number of routine matters. The most important of these was the selection of Horace A. Bonnell,

acting as general manager. Mr. Bonnell has been assistant general manager of the A. L. A. M. for about a year and was the logical selection for the post.

The action of the A. L. A. M. in honoring him may be said to foreshadow a larger and more important action of the Automobile Board of Trade.

Mr. Bonnell, while still a young man, is a veteran of the industry. His first interest in motordom was gained when he joined the ranks of automobile owners and became a member of the New Jersey Automobile and Motor Club. For several years he served that organization as secretary and was an active figure in the upbuilding of the club to the rank it held as the largest automobile club in the United States. He was primarily the cause of the reorganization of the Associated Automobile Clubs of New Jersey. In sporting matters he has been active and successful, and it was due to Mr. Bonnell more than to any one else that the Newark automobile shows have met with such a measure of success. He has acted as manager of that show for the past four years.

In the past his most effective work for the industry has been done along the lines of facilitating and promoting the use of automobiles through the improvement of roads. He believes that a club run in which fifty cars take part is one of the moving forces of the business, and consequently is a polished and accomplished advocate of good roads.

Personally Mr. Bonnell has a suave, kindly and diplomatic manner, is easy of approach and friendly in his conversation. He has an immense capacity for work and studiously applies it.

Briscoe Will Feed the Orphans

Benjamin Briscoe, president of the United States Motor Co., is going to act as host for the orphans on the occasion of the luncheon in connection with their annual automobile outing at Coney Island, June 7.

A letter from him to Col. K. C. Pardee, head of the Orphans' Day organization, offers to foot the bills for the luncheon that will gladden the children's hearts after their fine ride to the pleasure ground.

Many more cars will be required this year than ever before to accommodate the children and to date the voluntary donations have not kept up with the requirements in the same measure that they have in the past. However, it is expected that those who sympathize with this laudable charity will come to the front within the next week or two and that a column sufficiently large to carry many more children than last year will be provided.

Philadelphia Motor Truck Run

PHILADELPHIA, May 8—Philadelphia is to be treated to another demonstration of the serviceableness, reliability, time-saving and economy of the commercial vehicle to the merchant and the business man. On Thursday, June 8, the Philadelphia *Inquirer* will conduct a motor truck parade through the principal business thoroughfares of the city, concluding with an exhibition of the vehicles at the Belmont Driving Park, Marberth. The parade will not partake of the nature of a contest, such as the Philadelphia-Atlantic City test conducted by the Philadelphia *North American* a year ago, but simply be a practical demonstration of the motor-driven vehicle's supremacy in the solving of the transportation problem. The itinerary will be announced next week, a Kissel-Kar truck to be used to convey the pathfinders while mapping out a suitable route.

Iowa Town to Give $20,000 for Road

DES MOINES, IOWA, May 8—One Iowa town is going to spend $20,000 on good roads improvement during the present Summer. Valley Junction, a little town of 3,000 people, just west of Des Moines, has offered to give $20,000 for the improvement of the Polk County section of the famous River to River road through Iowa, if Polk County and the city of Des Moines will spend $3,000 in cutting 3 feet for a length of 700 feet along Grand avenue, the fashionable residence section of Des Moines. The county board of supervisors already signified willingness to bear half of the expense and there is little doubt but that the Polk County division of the road will be covered with a coat of shale or gravel this Summer.

Quakers Promote Electric Run.

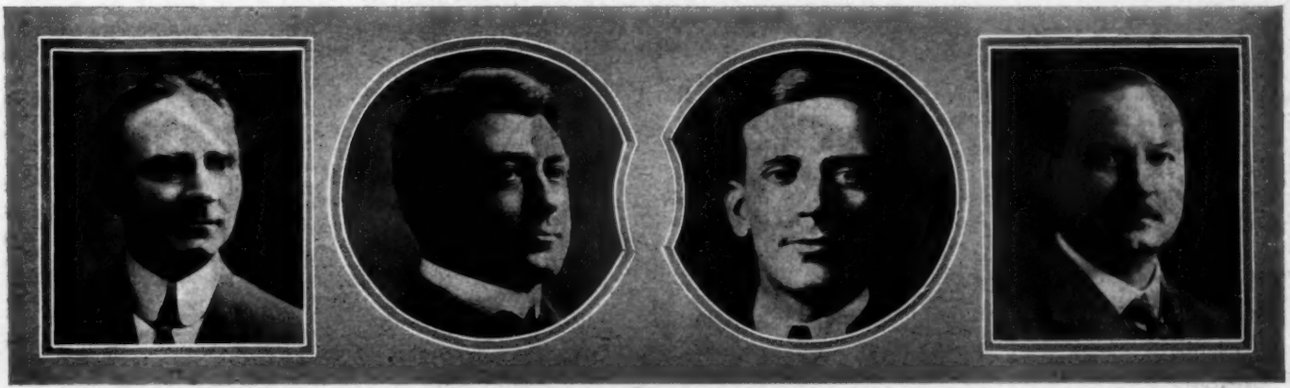
PHILADELPHIA, May 8—Simultaneously with the awarding of the trophies to winners in the recent social run of the club to Atlantic City, the announcement was made on Tuesday night that the Quaker City Motor Club will conduct a run exclusively for electrics on Saturday, June 10. No details, outside of the date, have been definitely decided upon as yet.

Century Club Is 25 Years Old

PHILADELPHIA, May 8—Members and guests to the number of about 200 helped to fittingly celebrate the 25th anniversary of the Century Motor Club Friday at a banquet held at the home of the famous club, 1606 North Broad street. J. Fred Hartmann, president of the organization, acted as the toastmaster, and Alden Weed, Thomas Hare, Walter A. Bailey and other former presidents of the club responded to toasts.

Will Entertain Gliddenites

PHILADELPHIA, May 8—The Quaker City Motor Club has launched a movement to fittingly entertain the Glidden Reciprocity tourists in the Washington-Ottawa event upon their arrival in Philadelphia on June 19. Secretary A. T. James is in charge of the arrangements.



H. A. Bonnell, Acting General Manager A. L. A. M.

S. T. Davis Jr, Locomobile Company of America

S. D. Waldon, Vice-President Packard Motor Car Company

Charles C. Hanch, Treasurer Nordyke and Marmon Company

S. A. E. Work Being Pushed Along

Problems of Standardization Melting by Treatment

Henry Souther, president of the Society of Automobile Engineers, tells of the progress that is being made in the work that the society is doing along lines akin to the efforts of the Master Car Builders, who make the building of railway equipment a regular thing, adding to safety and reducing cost. In quite a number of ways the society is doing good work and it is the fair claim that the membership will hit the 1,000 mark by the end of the present year.

Henry Souther, President Society of Automobile Engineers

THE automobile industry is a young one and much that goes with it is therefore in a state of development.

The same may be stated of the Society of Automobile Engineers, but it is gratifying to note that the Society is fast settling into its place and doing a most necessary work in the industry. Until last year, or perhaps even this year, progress in any attempt to standardize automobile engineering matters could not be rapid. The industry was too young and conditions were not ripe.

Experience now shows that conditions are ripe and the work of standardization is moving along with giant strides. All those interested, the producer, the consumer and the user are with the Society and its management and pushing to help bring about reasonable standardization.

There is some danger of going too far with standardization, but the various problems must be thoroughly discussed and threshed out in order to discover how far it is right to go; and that is just what the committees are now doing. It is very gratifying to see how all interests are pulling together in this matter. There is no opposition. Differences of opinion are being reconciled very rapidly.

Better than anything else in connection with this committee work, the members of the Society and those who go to make up the industry are becoming better acquainted with each other and are learning to better understand each other, and this always helps.

It is much easier to do business with a man one knows personally, whose views have been heard in committee work discussion, than to do business with one only heard about and of whom may exist serious misconception.

Standardization But One Phase of S. A. E Work

Standardization is not the only work that the Society of Automobile Engineers is undertaking. A number of its engineers are reaching out into the fields of investigation. They are preparing serious studies into engine performances, for example; studies that may take a year or two to work out. Others are working out formulæ that are new and which answer the needs of the automobile engineer. These formulæ have not been worked out before because there was a lack of empirical information and lack of experience, and the constants involved could not be obtained.

The membership of the Society covers, of necessity, a great many different kinds of engineers. It has already been pointed out that no one engineer designs every detail of an automobile. The man who designs the engine and the chassis in general, certainly does not design the magneto as a rule. The man who knows enough to design a good tire is not likely to know how to design a good radiator, and yet we may say they are equally important.

So, the membership of the Society is made up of a wide scope of engineering knowledge, and it must be if the Society is going to do the greatest good for the greatest number of people.

If the Society of Automobile Engineers is going to do as much for the automobile industry as the Master Car Builders did for the railroad industry, then the Society must be made up of engineers, superintendents, patent attorneys, rubber works managers, electrical engineers and so on through all of the industries that enter into the production of an automobile, either directly or indirectly.

The metallurgist and the steel maker are important factors. It is necessary that the consumer and the producer of steel and other alloys should work together, in order that each may understand the range and possibilities of the other's work. The committees of the Society are therefore made up, as far as possible, of members from the producing and consuming interests. Sometimes there are three elements introduced, as, for example, in the spring industry—the man who makes the steel, the man who fashions it into springs, and the man who uses the springs. All three must enter into the discussion of committee work in order to arrive at conclusions satisfactory to all and not unreasonable to any.

After specifications are duly formulated and the matter is fully understood, then perhaps the committees can be made up of purely automobile engineers. With new work, however, this is hardly possible; there must be a mutual interchange of information at the outset.

The membership of the Society is increasing rapidly; over 800 now, with the probability of 1,000 in the near future. It is hoped that this 1,000 will be reached at the time of the summer meeting, the middle of June. About the only obstacle seems to be as the result of procrastination. Many engineers have in mind joining, but it is something that can be done at any time and consequently it does not get done at all until someone comes along and actually suggests the name and puts the man up for membership. This is exactly what each member of the Society should do; find some one man who is a good man, who is eligible to membership, and who will make an active and interested worker, and put his name up. Ninety-nine times out of a hundred the man will be pleased. In this way good members will be obtained all over the country and the work of the Society of Automobile Engineers promoted in the broadest possible manner.

The printed transactions of the Society will contain much of the best engineering data and information, covering the entire automobile field, and become the acknowledged source of automobile engineering information.

May 30, Hoosiers' Big Day

International Sweepstakes, 500 miles, which will be decided on the Indianapolis Speedway on Decoration Day, has attracted a record field, and bids fair to attract a record crowd. Preparations have been completed for handling the vast assemblage, and every indication favors another high mark in the history of speed development. Inquiry for accommodations have increased to flood size, and motordom awaits the starting gun with intense interest.

INDIANAPOLIS, IND., May 8—With an entry list such as has never been approached before in the history of motordom the 500-mile International Sweepstakes which will be staged at the Speedway on May 30 has centered the attention of the automobile world.

Practically every make of car that has racing aspirations and practically every racing driver of national note has been engaged for the supreme struggle that will open the automobile racing season of 1911.

The race will be started at 10 o'clock in the morning, and

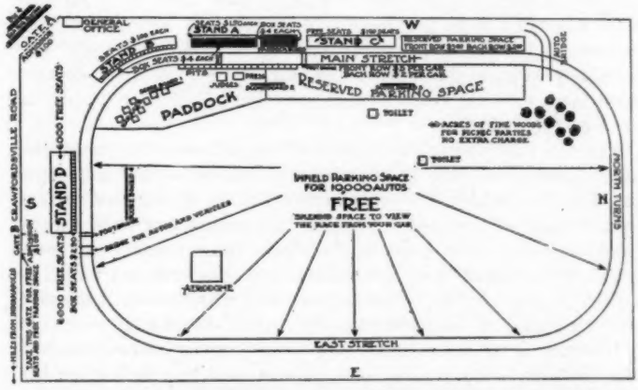


Diagram showing the arrangement of stands, parking spaces, paddocks, etc., at the Indianapolis Speedway, where the big International Sweepstakes at 500 miles will be run off on May 30

from the instant that the cars are sent away until nearly 5 o'clock in the afternoon the tremendous field will sweep around the brick course, searching for the shortest route to the $25,000 of prize money that will lie just beyond the finishing line.

Strong must be the car that wins, and it must possess supreme speed, flexibility and power. Behind its wheel the driver must make no mistakes, and he, too, must have a wonderful degree of strength, marvelous steadiness of nerve and uncanny skill. But in addition to all these things the winning combination must have good fortune. Little things may turn the balance one way or the other. Chance, luck and fortune must conspire with merit in order to determine the winner.

There will be an immense audience to witness the decision of the trial, and already the inquiry for accommodations has grown to large size.

Arrangements for the race have been perfected and all the details for handling a crowd of giant proportions have been prepared. The main body of the spectators will be seated on the west side of the track, where three big stands have been built. In addition there will also be a series of paddock boxes and a choice reservation has been made for parked automobiles, from which the contest may be viewed advantageously.

Queen City Automobile Activities

CINCINNATI, O., May 8—The Tenth Annual Anniversary banquet of the Automobile Club, of Cincinnati, held in the banquet room of the Gibson House, Thursday night, was the most successful affair of its kind ever given by the organization. The guests, 150, out of the 1,200 members of the club, included many of Cincinnati's wealthiest residents.

The arrangements for the banquet were in charge of Carl A. Streit, chairman of the Entertainment Committee. The speakers were: Jesse Taylor, Secretary of the Ohio Good Roads federation, Stanley E. Bowdie, and Harry L. Gordon.

The annual meeting and election of directors of the Cincinnati Automobile Dealers' Association, was held at the Association headquarters last night. The following directors were elected: Edward F. Herschede, chairman; Edwin F. Kruse, Kruse Motor Car Co.; Robert C. Crowthers, Crowthers Automobile Co.; W. G. Welbon, Olds-Oakland Motor Co.; H. S. Leyman, Leyman-Buick Co.; Frank H. Miller, Geo. C. Miller Sons Carriage Co.; and Geo. Behlen, of Chas. Behlen Sons Co.

All expectations have been exceeded by the officials of the Cincinnati Automobile Dealers' Association, in the matter of entries for the first of the series of automobile races to be given at Latonia, Ky., Saturday, May 13, and Sunday, May 14. About twenty cars have been entered in the various events and as the entry list does not close until Monday night more are expected. The cars entered so far are as follows: Five Buicks, one of which is from Dayton, O.; Two "Cino's" of the Haberer Co., of Cincinnati; one Elmore, two E-M-F's; one Empire; one Firestone-Columbus; one Ford Special; one Matheson; one Oakland; two Ohio Speedsters; one Packard; one Pope-Hartford; two Schachts and one Staver.

The program is as follows:

SATURDAY, MAY 13.

Event No. 1—Five miles, for cars of Class C, with piston displacement of 161 to 230 cubic inches.

Event No. 2.—Five miles, for cars of Class C, with piston displacement of from 231 to 300 cubic inches.

Event No. 3.—Ten miles, for cars of Class C, with piston displacement under Class E regulations, ranging from 301 to 600 cubic inches.

Event No. 4.—Ten miles, free-for-all handicap.

Event No. 5.—Ten miles, free-for-all handicap.

Event No. 6—One-hour race for cars of Class C, under Class E regulation, for those not exceeding 600 cubic inches. This race is to be for the special $500 trophy.

SUNDAY, MAY 14.

Event No. 7.—Two miles, for stock touring cars with five passengers including drivers.

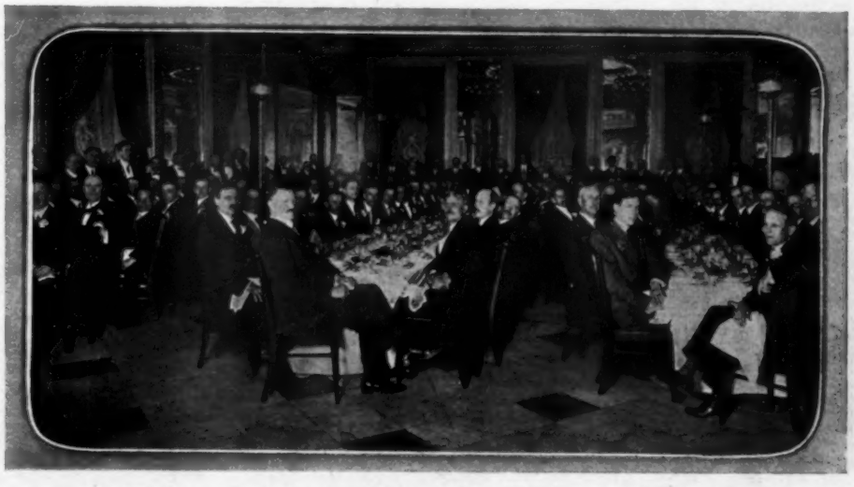
Event No. 8.—Five miles, for cars of Class C, with piston displacement of 161 to 239 cubic inches.

Event No. 9.—Five miles, for cars of Class C, with piston displacement of 231 to 300 cubic inches.

Event No. 10.—Ten miles, for cars of Class C, with piston displacement of 301 to 600 cubic niches.

Event No. 11.—Ten miles, free-for-all handicap.

Event No. 12.—Fifty miles, free-for-all cars under Class E regulations for those not exceeding 600 cubic inches. The race to be for the $500 special trophy.



Tenth anniversary banquet of the Automobile Club of Cincinnati

Fixes Dimensions of Solid Tires

Work of Sub-committee on Solid Tires Completed

Presenting the report of the Sub-committee assigned to the deliberation on wheels, rims and tires, under the tutelage of the Standards Committee of the S. of A. E. The report reflects a painstaking and ambitious effort on the part of the committee, resulting in the unification of the many conflicting situations, and the good that should come from this effort must have its equivalent in dollars, not only saving cost to the makers of cars but reducing the expenses of maintenance to the users as well.

AFTER holding several meetings, including conferences with tire manufacturers, wheel manufacturers and commercial vehicle manufacturers, the wheel dimensions and fastenings for tires division of the Standards Committee of the Society of Automobile Engineers has come to a definite decision and made its report, as given below.

The report is subject to the approval of the whole S. A. E. Standards Committee, which consists of about eighty members at work upon the standardization of the whole field of motor vehicle manufacturing practice. The procedure to be followed in making this report a part of the final standards accepted by the S. A. E. is as follows: The recommendations appearing below are now being voted upon by the members of the whole S. A. E. Standards Committee. Upon affirmative action by this committee the report will, after the approval of the society council, be submitted to the whole society membership for its acceptance.

It is interesting to mention here that while the initial undertaking of this project presented almost insuperable difficulties, when the commercial importance of affecting standard methods of wheel manufacture and tire application was completely set before those departments of the industry at interest, they immediately expressed willingness to co-operate even at considerable outlay for new methods or loss of present investment, which was extremely gratifying, and has practically assured the complete success which has attended the committee's effort. The tire companies, which could probably not have been reconciled to uniform practice by any other means, readily assented to the solution of the problem by such a qualified, disinterested and important body as the Society of Automobile Engineers.

It was learned, first of all, from the vehicle manufacturers that the idle investment which they were compelled to carry in wheels, due to the diversity of tire equipment and the fact that a tire specification is the last item in the purchase of vehicle equipment, that considerable loss was annually involved by the obsolescence or depreciation of wheel stock equipment. This, in the case of one truck manufacturer, has amounted to $10,000 per year, which may be taken as an indication at this early stage of what might be involved later with the development of the truck business.

United States Motor Company's Retail and Service Building in Detroit

The wheel manufacturers' case proved that, owing to the necessity of procuring lumber for seasoning long in advance of the market demand for completed wheels, they have been particularly burdened with investment in a direction which has been extremely indefinite. Standardization of practice would immediately release this investment for its use in their current manufacture, with a consequent modifying influence upon the price of their product.

The tire manufacturing division of the industry has developed under such a diversity of practice that, instead of an open market, and particularly the future market, most of the tire makers find themselves confined to a field of business restricted by the employment of their particular devices, and wherever this field could be enlarged this accomplishment was effected only by serious change in the wheel equipment, which were expensive and ultimately a detriment to the user. By the adoption of uniformity in wheel structure the entire market among users is thrown open to every tire manufacturer, and this fact alone has proved sufficiently interesting to warrant almost complete new mold equipment and other radical changes in methods of manufacture, which, though involving immediate heavy outlay, is certain to reduce the unnatural expense which has heretofore existed. Another consideration among the tire manufacturers has been that, owing to the difference in cross-section and profile, some manufacturers have had a considerable competitive advantage over others. Standardization will effect a certain uniformity of tire cross-section or quantity of rubber employed per tire, which will in turn rduce competition to a more normal basis.

The foregoing considerations bring into prominence the fact that the ultimate consumer, or truck user, must finally bear the burden in price resulting from existing conditions, and therefore the effect of standardization will be to more readily promote the use of commercial motor vehicles in contributing to their reduction in cost. Aside from this prime consideration the user has the advantage of interchangeability with all makes of tires, which gives him the retroactive benefit of a broader supply of equipment with consequent commercial considerations, which naturally follow.

The Report of the Committee

"As the result of six meetings of your committee since its appointment in January, 1911, a conference with the representatives of tire and wheel manufacturers, and considerable supplementary correspondence with these tire manufacturers and wheel and vehicle builders, your committee desires to make its final report on that division of its work relating to wheel dimensions for solid tires, and therefore respectfully submits for your acceptance and approval its findings as expressed in the following resolutions passed at our recent meetings held in New York, May 4, 1911:

"*Resolved*, That the wheel dimensions and fastenings for tires

division of the Standards Committee recommend for acceptance by the Society of Automobile Engineers the following as standards for dimensions of wheels for solid tires:

Wheel Dimensions for Non-demountable Tire Equipment —Metal Bands

"There shall be a permanent metal band on all wheels in advance of shipment by wheel manufacturers.

"This metal band shall be one-quarter inch (¼") thick on wheels for single-tire equipment up to and including four (4") inch nominal width of tire; and three-eighths (⅜") inch thick on wheels for single-tire equipment above four (4") inch nominal width of tire; and three-eighths (⅜") inch thick on wheels for dual equipment of all tire sizes.

Wheel Diameters

"There shall be a constant wheel diameter over the metal band for all widths of solid tires of a given nominal overall tire diameter. Nominal tire diameters shall increase or decrease from thirty-six (36") inches by even two (2") inches.

"The constant diameter for a wheel taking a thirty-six (36") inch tire shall be thirty (30") inches over the metal band, and shall increase or decrease by even two (2") inches for tires larger or smaller than thirty-six (36") inches.

Width of Felloe and Width of Band—Single Tires

"The width of felloe and band shall be three-quarter (¾") inch less than the nominal width of the tire equipment for same. For example, the standard felloe width for four (4") inch single tire equipment shall be three and one-quarter (3 1-4") inches.

Dual Tires

"The width of felloe and band for dual tire equipment shall be twice the nominal width of each of the dual tires. For example, the standard felloe width for four (4") inch dual tire equipment shall be eight (8") inches.

Tolerance Over Metal Band

"The tolerance allowable in the circumference of metal bands shall be as follows:

"Before application to wheel—Minus, 0; plus, 1-16 inch. After application to wheel—Minus, 0; plus, ⅛ inch.

Minimum Depth of Wood Felloe

"The minimum depth of wood felloes shall be as follows:

Tire Size. Inches.	Felloe Depth. Inches.	Tire Size. Inches.	Felloe Depth. Inches.
2	1¼	6	2
2½	1¼	6½	2⅛
3	1½	7	2⅛
3½	1½	7½	2⅛
4	1¾	8	2⅛
4½	1¾		
5	2	Above 8	2¼
5½	2		

For Demountable Tire Equipment

"All of the foregoing provisions for non-demountable tire equipment standards, viz., equipment of wheels with metal bands, the constant diameter of wheel over metal band, the stated variation of wheel diameter, the width of felloe, the tolerance over metal band and minimum depth of wood felloe, shall apply to wheels for demountable tire equipment.

"*Resolved*, That this report be presented to the Standards Committee for its approval, with the recommendation that, in view of the urgent commercial necessity for decision in settlement of the standards in question, a mail vote of the Standards Committee be taken and rendered promptly to the council of the society for approval as to submission to the entire membership for final acceptance.

"It is the opinion of the committee that the ground has been so thoroughly covered as to warrant a definite and final action without further delay, and that the commercial use of these standards should go into effect not later than January 1, 1912, as the intervening period appears to provide reasonable allowance for the manufacturing changes involved. Respectfully submitted:

"William P. Kennedy, *Chairman*. J. M. Mack,
C. B. Whittelsey, C. B. Hayes,
C. L. Schwartz, J. A. Anglada,
E. R. Whitney, Coker F. Clarkson, *Secretary*."

Pennsylvania Federation Election

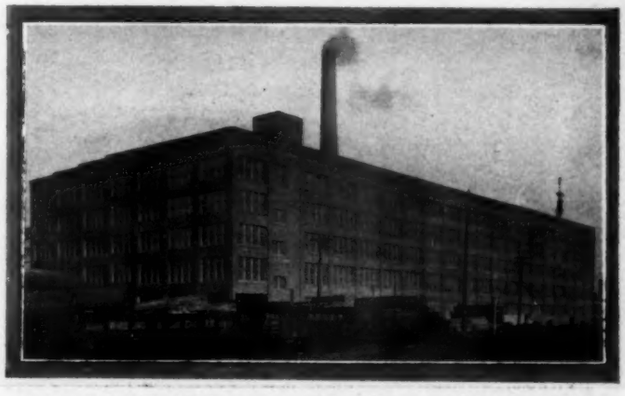
Philadelphia, May 8—The annual convention and election of officers of the Pennsylvania Motor Federation were held here Saturday at the headquarters of the Automobile Club of Germantown, Carpenter and Emlen streets. Many prominent Pennsylvanians are actively connected with the Federation and it is one of the strongest organizations of its kind in the United States. The improvement of existing roads, building and maintenance of first-class highways in all sections of the State, the supplying of general information to tourists, obtaining Federal aid in the building of national highways in Pennsylvania, abolition of toll-gates, the protection of motorists from drastic legislation and the furtherance of automobile racing along legitimate lines, demonstrate the scope of its interests. In addition, the Federation is lending a hand in the effort to establish the proposed Lincoln Memorial Highway from Washington to Gettysburg.

Nearly 100 delegates, representative of 40 of the State's leading motoring clubs, attended the meeting to-day and listened to reports made by the several committees, the convention concluding with a ride through Fairmount Park and a banquet at the Racquet Club to-night. President Robert P. Hooper presided over the meeting.

The passage of State Senator Sproul's highway improvements bill was approved as originally framed, but strong objection was raised against amendments tacked on in the Lower House of the Pennsylvania Legislature increasing the mileage of the roads proposed to be improved by 60 per cent., claiming that the surplusage would kill the very object for which the bill was framed by reason of the excessive cost.

Several automobile clubs were elected to membership in the Federation, including: The Automobile Club of Warren, the Corry Motor Club, the Slatington Motor Club, the Vandegrift Motor Club, the Clinton County Automobile Club and the Chambersburg Motor Club.

All of the old officers were re-elected, as follows: Robert P. Hooper, of the Germantown Automobile Club, president; vice-presidents, John A. Wilson, Franklin, Pa.; Peter A. Meixell, Wilkes-Barre, Pa.; Powell Evans, Automobile Club of Philadelphia, and W. R. Stephens, Automobile Club of Wilkinsburg; secretary and treasurer, Paul C. Wolff, of the Automobile Club of Pittsburg. Committee Chairmen: John H. Weeks, Good Roads; Boyer Dairs, Legislative; David Jameson, Touring; Publicity, J. H. Beck.



Main plant of the Goodyear Tire and Rubber Company at Akron, O.

Trade News from Detroit

DETROIT, May 8—Detroit manufacturers of motor cars are strongly in favor of reciprocity with Canada which will permit the product of their plants to be shipped into the Dominion free from duty. Several of them have gone on record to this effect and have signified their desire to their representatives at Washington. At present American motor cars are sold in Canada at an advance in price ranging about 30 per cent. more than the figures in force in the United States. Some of the large Detroit factories support branch factories in Canada, to which parts are shipped, to be assembled on Canadian soil. The duty on parts is considerably less than that on completed cars, though this is balanced to a certain extent by the increased overhead and other expenses incident to the maintainance of an additional plant.

That Canada presents a most promising field for the American motor car is universally believed by the Detroit manufacturers, nearly all of whom have already cultivated the Canadian field with considerable success, despite the handicap to American goods in shape of a discriminating tariff.

The Metzger Motor Car Co. has added L. L. Barnes, formerly southern manager for the Hudson Motor Car Co., to the sales department. E. E. Wright, formerly with the sales department of the Chalmers, has also accepted a position with the Metzger Co. and has been assigned headquarters in Indianapolis and Chicago.

An important appointment has been made by the Lozier, Harry T. Scott, succeeding to the position of sales manager of the Detroit branch. He will be assisted by Robert L. Messimer and R. A. Whitehead. The Lozier Co. has had a special staff of men under drivers Tetzlaff and Mulford, busy for more than a week, testing out and tuning up the two cars which the drivers will pilot at Indianapolis. The cars were examined by Chairman Edwards during the week and have been in use on the country roads east of the city. They will be sent to Indianapolis shortly.

The Lozier sales department has been busy all week, entertaining the dealers of the firm who have gathered from all parts of the country for purposes of convention and to become posted on the new models. The sessions of this convention are usually held in June, the present being rather in the nature of an informal gathering to allow the men who sell the cars to become acquainted with the new models and the new factory.

The Packard Motor Car Co. has begun a large addition to its immense plant on the Boulevard. The new buildings will be devoted to an extension of the truck department. The additional room will allow the company to increase its production from three to five trucks a day. The new plant will include 9,695 square feet of floor space. In all probability part of the building will be devoted to the manufacture of public service vehicles.

The prosperity of the motor truck manufacturing establishments continues to be a feature of the season's business. The Alden Sampson Manufacturing Co. is pushed to its limit and has its men working nights and overtime to take care of its orders.

The retail department of the Alden Sampson is being installed in the new building of the United States Motors Co. on Woodward avenue. This building, said to be the most complete of its kind in the country, will be given a formal opening this week, with the removal of the offices of the company from its old location on Jefferson avenue.

The new building includes separate departments for Maxwell, Columbia and Alden Sampson trucks, as well as a store for the sale of used cars. The upper floors will contain suites of offices not only for the sales staff of the local branch but also for President Frank Briscoe of the Brush Runabout Co., O. J. Mulford, president of the Gray Motor Co., and all the district heads of the various departments of the United States Motor Co., Robert J. Davis is the sales manager in immediate charge.

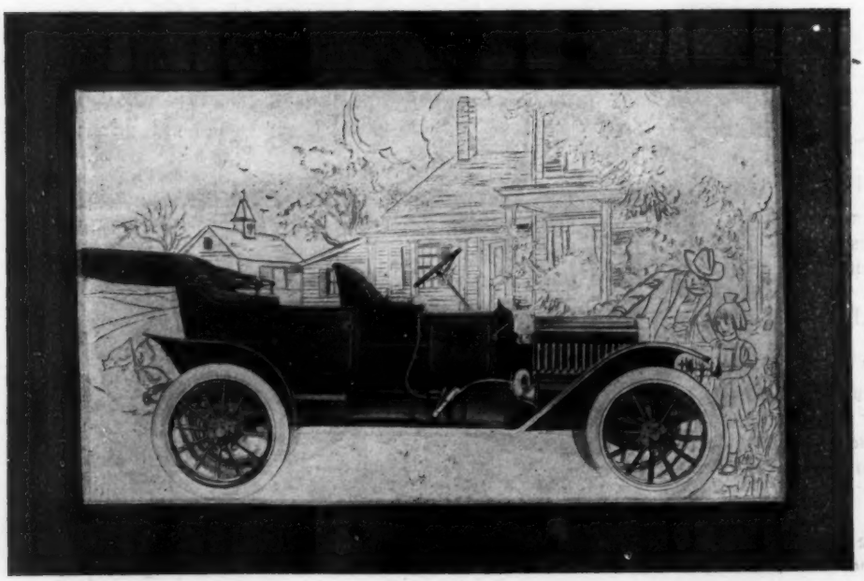
The local retail trade chronicles another shift in the appointment of William H. Foster, formerly of the Packard, as the local sales manager of the Thomas agency. Temporary headquarters have been secured at 742 Woodward avenue.

Crude Rubber at Low Level

AKRON, O., May 8—The price of crude rubber has dropped to $1.18 a pound, which is lower, with one exception, than it has been in years, and local rubber manufacturers, all of whom must make their large tire contracts without reference to what rubber may cost them months hence, are breathing easier. The $1.18 quotation applies to "fine up-river Para," a standard Brazilian grade of gum of which large quantities are used in the United States, including many thousands of tons annually in Akron. Two weeks ago crude rubber reached the low-water mark of $1.12 a pound. A few months ago it was $1.70.

Fluctuations in the price of this exceedingly valuable raw material have made one of the most serious of the problems in tire manufacturing. Tire manufacturers make their contracts with automobile firms once a year. Contract prices of tires must cover possible rises in the price of rubber if the tire man is come out whole and with a profit, and must be low enough to compete with other tire manufacturers.

The present low price is the result of the smashing of a corner in Brazil. Rubber is Brazil's staple export. It is the largest source of Brazilian official income. About a year ago the Brazilian government entered into an arrangement with its rubber producers (the product itself is wild and gathered by natives, so that most of its producers are really brokers), by which crude rubber could be stored indefinitely in government warehouses, and the owners could borrow money on it up to two-thirds its value. By this method it was hoped to force the price upward, so that the result would be enormous profits for government and rubber producers. American rubber manufacturers retaliated by failing to buy any more rubber than was actually required to keep them going. The price rose to $1.70 and there it stopped.



Showing the Maxwell fore-door type of touring car, with neat-fitting top

The Brazilians let go a little of their supply, hoping to profit at that price, but the rubber manufacturers still held off, and the entire corner tumbled, producing the present rates at which Akron manufacturers are buying a liberal supply. Local rubber brokers have word that the Brazilian corner will be renewed before the middle of May, but say there is nothing to confirm the report. Thus far Brazil's flyer, while it has embarrassed American manufacturers seriously for a time, has not been what might be termed a pronounced success.

High Pressure on at Akron

AKRON, O., May 8—All the Akron rubber factories whose lines include automobile tires continue to employ night shifts as well as day shifts of men, and the production is close to the capacity of the local factories.

In other years a lull from the top notch activity of mid-winter has been noticed about this season. Manufacturers explain this year's peculiarity by calling attention to the fact that auto manufacturers generally hesitated longer than usual last fall and winter before putting 1911 plans into operation, and tire contracts were in many instances delayed until the last minute. Then came the deluge. The very moderate business activity of other cities of the country has caused Akron to stand out by contrast as a "paradise" for laboring men, with the certainty of good wages and steady employment for tire makers and tire workers. Expert tire makers are graduated from "green hands" in a few weeks' time. Though men are being employed every day, there are far more applicants than jobs, some members of the army seeking work having traveled as far as 1,000 miles to "get in on" Akron prosperity.

Akron's Chamber of Commerce is now taking steps to send out accurate information in regard to Akron's industrial situation, so that there will be a falling off in the number of men, some of them with families, who come here seeking work without resources of their own, and consequently have to be cared for by the city poor authorities.

Mound City to Have a Show Under Canvas

ST. LOUIS, May 8—A tented show is scheduled for St. Louis in the fall, said to be the first motor exhibit ever held in circus style in any large city in the United States. Under the big tents there will be as many rings as there are exhibits, and the very novelty of the scheme insures its success.

The St. Louis Automobile Dealers' and Manufacturers' Association, of which about sixty of the principal retailers and builders of this city are members, is to be sponsor for the event. At a meeting of the Board of Directors held last week this was finally decided. A show committee was appointed, with instructions to secure all available attractions for the big show, which is to take place Oct. 2 to 7, the week of the "Veiled Prophet," St. Louis' annual Fall carnival. At that time many thousands of out-of-town visitors arrive for the festivities, and excursion rates are made from the surrounding country on all railroads. Another reason for holding the show so early is that the new models will then still be novelties, instead of being only a repetition of the cars which may be seen on the street at any time, as is the case when the show is held in February.

There will be two divisions of the exhibit under canvas, one for pleasure cars and the other for commercial vehicles. There also will be shows for accessories.

Firestone Factory Nearly Ready

AKRON, May 8—The new factories of the Firestone Tire & Rubber Co., located half a mile southeast of the company's present plant, are very near completion. It was announced to-day that the office force would be removed to the new buildings not later than June 1, and that the factory forces would follow soon afterward, the date of the general removal depending on the time required for the installation of machinery. The entire old factory of the Firestone Co. will be used for the manufacture of rims. The company now employs more than 1,000 people and plans are to triple the plant's capacity within a year and increase the number employed to about 3,000.

A year ago, when it became necessary to extend the factory, it was decided not to add to the old buildings but to build an entirely new factory.

Rambler Adds Two New Buildings

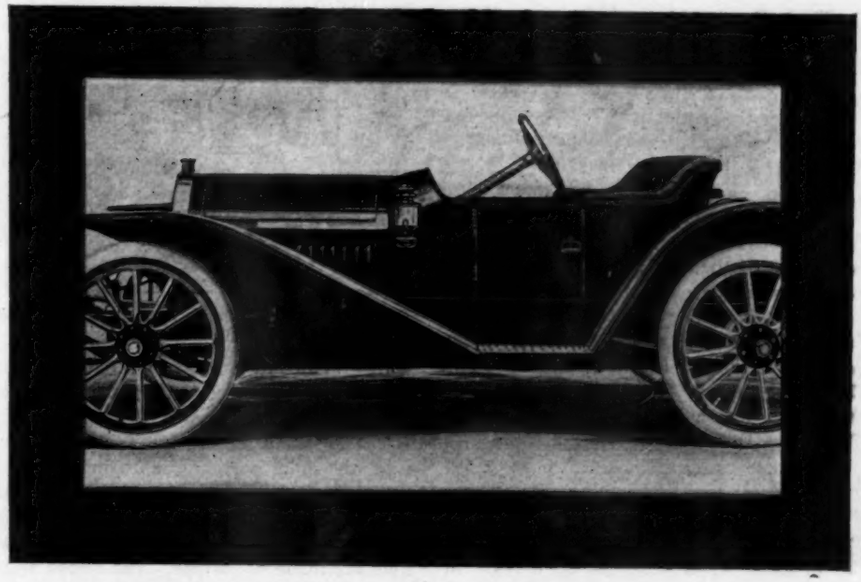
KENOSHA, WIS., May 8—Two large additions to the establishment of the Thomas B. Jeffery Co., are in immediate prospect. An addition to the drop forge plant is now in course of construction and ground was broken to-day for a new building to be known as the Finished Car Department. This will be 200 by 60 feet. The additions will be used to facilitate the making of parts now manufactured elsewhere rather than to increase the Rambler output. About 22,750 square feet of floor space will be added to the factory equipment.

Many Cars for Southwest

AKRON, O., May 8—A. L. Gustin, a field worker in the West for the Diamond Rubber Co., now at the home plant, brings word that Kansas City will this year be the distributing point for an unprecedented number of automobiles for Southwestern territory. Kansas City ranks as the transportation gateway to the Southwest, and a large number of the machines to be distributed from here this year are for rural or semi-rural use, in Texas and the other large spaces in the southwestern States.

Page Goes to New Departure

Victor M. Page, a prominent technical writer on automobile topics who has been connected with various publications affiliated with the motor industry, has accepted a position with the New Departure Manufacting Co. Mr. Page will devote his attention to the ball-bearing division of the Bristol, Conn., company.



Regal "20" runabout with underslung frame, straight-line body design and cowl dash

New Things Among the Accessories

Characteristics of Burn-Boston Battery

THE Burn-Boston battery as shown in Fig. 1 is of the zinc-carbon type, with the zinc acting as the jar, and it is made square in shape so that it will store economically. The carbon composes the central electrode. The basis is sal-ammoniac, to which is added a second solution for the purpose of preventing the battery from freezing in cold weather. In the making up of the zinc to form the shell and an element combined, mechanical strength is taken care of automatically, in view of the property interposed through the alloying of the zinc, which was done, however, for the purpose of preventing local action. As a further step in the direction of limiting local action, and for the purpose of obtaining a constant density of the electrolyte, the sal-ammoniac solution is given a special treatment that has been found efficacious for the purpose, and in the finishing of the shell it is made waterproof through the use of fibrous material impregnated with impervious compounds which are put into the fibrous material by a vacuum process, after which the product is compressed to render the same tight. The completed cell has a capacity of about 20 ampere hours, and the voltage is said to be 1.5. In service, in view of the low internal resistance of the cell, coupled with the constancy of the electrolyte and the efficaciousness of the zinc alloy, the current recedes but slowly, and the voltage persists for a considerable length of time. Six types are made varying in size to suit specific requirements, in all cases the voltage being 1.5 per cell. This battery is made by the Burn-Boston Battery & Manufacturing Works, 9 Doane street, Boston, Mass.

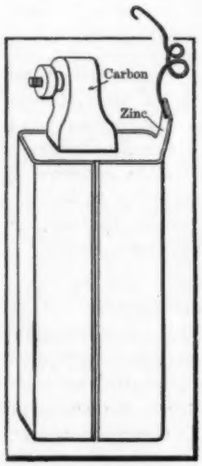


Fig. 1—Exterior view of the Burn-Boston Battery

To Facilitate Raising the Top

IT often happens that the driver of the car is alone when it comes on to rain or perhaps that ladies are the occupants of the back seats. In order to lift the top and do so quickly he will have to call a passer-by or invoke the assistance of the passengers. The device shown in Fig. 2 is intended to render the lifting operation easy and such as one person can perform unaided. With a large top the bows are usually very unruly and unless great care is exercised they are liable to damage the paint work. The turned end of the raiser hooks into the eye of the front gooseneck. The other end is secured to the rear bows by a strap. The two bows that extend forward are hooked into the slide. By going to the other side of the car the top can be raised as though some one were helping, as the bows that are in the slide will slip forward. The Murray top raiser can be carried under the rear seat or cushion and the fitting is manufactured by P. A. Murray & Company, Newton, Mass.

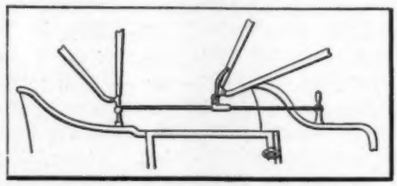


Fig. 2—Showing the Murray Top Raiser in position for lifting top

Handy Power Air Pump

AMONG the different mechanical methods of inflating tires now on the market the Hanna patent power air pump, shown in Fig. 3, is one of the latest. This pump is made in several models and the type illustrated is known as Junior Style B. The pump is of the double-cylinder type, the body portion comprising the two cylinders is one casting, and is made of cast-iron polished and lacquered. The cylinder walls are machined and the pistons are made of leather. The piston rods are connected by a simple mechanical device to obtain the reciprocating movement. The pump has been designed so that it can be installed on several makes of cars without structural alterations. This model is driven by a split gear furnished with the pump and placed permanently on some exposed shaft. To operate the pump the clamp is loosened and placed around the split gear which has guiding collars fitting the clamp and firmly locking same. The hose connection can be seen and the outfit consists of the pump together with gears, hose, connections and pressure gauge. The larger type of pump has phosphor bronze cylinders and steel pistons which are fitted with two piston rings. The method of drive is by direct gearing, and can be attached to any car having an exposed shaft so that the gear can be connected, the water-pump shaft serving for the purpose. It is manufactured by the Troy Auto Specialty Company, Troy, N. Y.

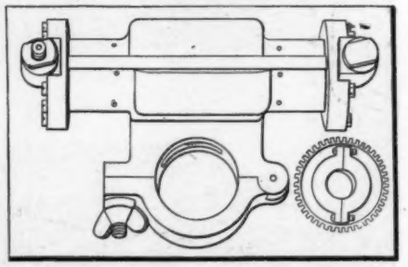


Fig. 3—View of the Junior Style B Hanna Power Air Pump

A Simple Warning Signal

SIMPLICITY is the keynote struck in the manufacture of the Joey-Mell warning signal. The call of the open road reminds one that it is necessary to have a signal on the car that is capable of giving an audible sound of approach round corners and sufficiently far ahead to let other users of the highway know that one is desirous of passing. The waste products of combustion are utilized in the device shown in Fig. 4. The Joey-Mell is attached to the exhaust pipe before the latter enters the muffler and from the simplicity of design it will be seen that there is nothing to get out of order. The attachment has an inside thread which is screwed on to a bifurcated extension of the pipe and the noise is produced by the elastic expansion of the "fluid" at the point of no support due to the nicking of the tube and resulting in the vibrations of the bell end. It is manufactured by the Joey-Mell Company, 1407 Michigan avenue, Chicago, Ill.

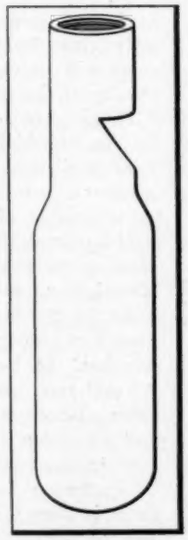


Fig. 4—View of the Joey-Mell Warning Signal, showing nick and inside threads.